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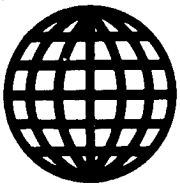

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ADVANCED MATERIALS

FRG's BASF Expands Composite Materials Research, Production

36980083b Duesseldorf HANDELSBLATT in German 11-12 Nov 88 p 29

[Article: "BASF: Big Plans for High-Performance Composite Materials. At the Very Beginning of an Era of Rapid and Continuing Development]

[Text] With optimistic expectations and ambitious plans, the BASF group is engaging in the development and manufacture of high-performance composite materials. Even though this type of product represents a still relatively new field of endeavor, the company expects to achieve a leading position in the next few years.

Speaking to journalists in Ludwigshafen, Dr. Franz Haaf, head of the high-performance composite materials division of BASF, said that this class of materials is just now entering an era which will be marked by rapid and continuing development. The market sales volume represented by composite materials is estimated by BASF to be around 2 billion U.S. dollars, with growth rates of 15 to 20 percent. The market sales volume is expected to increase to around $5 billion as soon as 1995, with the U.S. continuing to be the most important regional market, followed by Europe and the East Asian region.

The Ludwigshafen group has quoted its world-wide sales volume in this regard at around DM 600 million, and growth is said to be rapid. It is hoped that sales will have reached a level of DM 1 billion as soon as the early 1990s, with a marked improvement in the market share, and this division of the company is expected to start making a positive contribution to overall company success beginning in the early 1990s, Haaf said.

An important step toward expansion of activities was taken by the company recently in the startup of a research and manufacturing center for high-performance composites with an annual capacity of 6 million square meters of semifinished products at the Ludwigshafen facility. With this facility, built at a cost of DM 50 million, the company also has at its disposal development and manufacturing facilities for the European market.

BASF entered this new product area in 1985 with the acquisition of the composites division of the Celanese Corporation. By adding this new range of products to the existing marketing network of the Celanese subsidiary Namisco, BASF immediately established a base for its European operations. A joint venture with the Japanese plastics manufacturer Toho Rayon is simultaneously establishing a support structure for BASF's East Asian market activity. Haaf said this division of the company invests around DM 150 million per year, equally divided between material assets and research activities. Haaf said that BASF will invest several hundred million DM in high-performance composites, thereby making this product area one of the most important areas of activity for the future next to biotechnology.

Characteristic of composite materials is a mesh or even a parallel composite arrangement of fibers made of carbon, glass or Aramid embedded in plastics—usually reaction or epoxy resins. The main advantages of these materials is their excellent mechanical properties combined with relatively low weight. The most important application today is in aviation and aerospace technology which currently absorbs approximately 70 percent of overall production; 20 percent goes to the sport and leisure sector and about 10 percent to automobile and machine construction. Haaf sees the chances for certain composite materials in automobile construction, particularly for car bodies, as very good over the medium term. In this regard, BASF is also involved in the development of finished parts such as leaf springs and drive shafts within the scope of so-called "leading-edge projects." Positive results are also expected as the result of activities in the area of high-performance thermoplastic composite materials. According to BASF, this class of materials, which is characterized by improved resistance to high temperatures, increased strength and greater ease of processing, will increase its share of the overall composite materials market from the current one percent to about 30 percent by the turn of the century.

FRG: Prospects for Ceramics Research at Max Planck Assessed

3698M054 Munich MPG SPIEGEL in German No 4, 29 Aug 88 pp 10-12

[Text] Over the last few years basic research on high performance ceramics has been progressively intensified at the Powder Metallurgy Laboratory of the Max Planck Institute for Metal Research. The result has been intensive development of industrial practice and further challenges for research. The Max Planck Institute for Metal Research has taken up this challenge and increased its emphasis on high performance ceramics research. Extra space was needed to accommodate the special requirements of modern ceramics research such as clean rooms, powder laboratories, and high temperature equipment. To meet this need, the Land of Baden-Wuerttemberg has financed the construction of laboratories for ceramics research.

As early as the beginning of 1987, a team that had previously been formed at the Institute was able to start scientific work for the production of ceramic materials. The 17-man group has since increased to 30 with the addition of guest scientists, doctoral candidates, and postdoctorate researchers. It will be subsidized for 7 years by the FRG Ministry for Research and Technology within the framework of the materials research program. Fifty percent of the subsidies will be provided by the ministry and the remainder jointly by Bayer AG, Daimler-Benz AG, Hoechst AG, and MTU.

The scientific work focuses on developing ceramic materials with high reliability under severe mechanical and thermal stress, good corrosion and thermal shock resistance and creep strength, plus the ability to withstand long periods of use (at least 2,000 hours) at temperatures in excess of 1,500 degrees C. This kind of material could well provide a breakthrough in technical concepts that have so far proved elusive for want of suitable materials. Materials based on silicon carbide (SiC), silicon nitride (Si_3N_4), aluminum nitride (AlN) and zirconium dioxide (ZrO_2) hold out good prospects. We do not yet have a full basic understanding of these materials and there is no reliable source of information on which technical developments may be based. Thus, systematic research must be initiated to integrate production, processing, structure, and properties, thereby providing the requisite knowledge about the behavior of the materials under complex strains.

The ceramics team has consequently undertaken research on powder production and preparation, structural composition and optimization, strength—strength at high temperatures, in particular—and the closely related question of the materials' predicted lifespan (i.e., the time it takes for material to wear out under given conditions). Results have already been obtained in all three sectors, extending both basic knowledge and insights into the materials' technical potential.

Like conventional ceramics and powder metallurgical materials, high performance ceramics are produced from powders that are pressed into a "green compact" and then bonded by sintering. During sintering the powder particles are "baked" either directly (fixed phase sintering) or by smelting, which has an adhesive effect (fluid phase sintering). The strength of the resulting ceramic depends to a large extent on the faults that always arise during the complicated bonding process. Only in the rarest of cases can irregularities in the green compact, e.g., thickness fluctuations, differences in texture, heterogeneous concentrations, or even foreign particles introduced by unclean handling be eliminated during the subsequent sintering process.

Generally speaking the faults are accentuated by the irregular shrinkage of the green compact that occurs during sintering. An advanced powder preparation technique is therefore just as decisive a condition for the quality of the end product as the production of a fault-free green compact. However the extremely fine powder that must be used for high performance ceramics makes this particularly difficult to achieve, as the size of the powder particle is between 0.1 and 0.005 micrometers. It is very easy for agglomerates measuring between 10 and 100 micrometers to form in such fine powders, hindering the production of homogeneous green compacts. Even with high pressure pressing (500 MPa), traces of these agglomerates remain in the green compact and the mass is unevenly sintered, so sintering errors occur that reduce strength.

As the sintering temperatures and times are not normally sufficient to chemically homogenize the various components, even greater levels of purity and homogeneneity are required of the initial powder. The extremely pure, homogeneous powders or powder blends required as the basic material for high performance ceramics can be produced by, among other methods, what is known as the sol-gel process. Sol-gel processes are based on separating out highly insoluble hydroxides from watery alcoholic solutions of metal chlorides, nitrates, sulfates, or alcoxides by adding ammoniac (raising the ph level) or by simple hydrolysis. The first result is the creation of sols with particle sizes ranging from 0.01 to 0.1 micrometers. These particles are subject to what is known as Ostwald ripening, in other words, the larger particles grow at the expense of the smaller ones. Partial removal of the solvent or destabilization of the sol, e.g., by altering its ph value, will give rise to an an agglomeration or polymerization of the sol particles into a gel. Once the gels are dried, the hydroxides are transferred to the ceramic metal oxides under dehydration at 500 to 800 degrees C.

The simplest variant of the sol-gel technique is coprecipitation, which means the simultaneous precipitation of two or more metal hydroxides. Although normal coprecipitations give very fine powders, they separate out. There are other processes that give very homogeneous powders, but they cause comparatively hard agglomerates. Only when a new combination of the sol-gel process with a nozzle method was developed at the Institute, could a powder be produced that was both sufficiently homogeneous and fine-grained.

In contrast with metallic materials, the strength of ceramic materials basically improves as its toughness (i.e., the resistance of the material to crack propagation) increases. Thus material can be used with a higher concentration of faults, which cause brittleness in ceramics and can never be completely eliminated. Exceptional strength requires both a reduction in faults and an increase in toughness through structural optimization.

This kind of optimization can be achieved, for example, by embedding long fibers made of stronger substances in the materials. As in reinforced concrete, forces are transferred from the ceramic to the high tensile fibers. The amalgamating material then remains intact even if a part of the matrix is broken. Even relatively short, monocrystal fibers known as whiskers have similar effects. Cracks are deflected by the whiskers and forced to follow longer routes (crack deflection) before they can cause a break in the material. If a whisker lies across a crack, it can hold the sides of the crack together, contributing in this way to increased toughness as well. The crack can only continue if the very strong whisker is detoured, destroyed, or pulled out of its original position. Such strengthening mechanisms can be used in conjunction with the conversion reinforcement process previously discovered at the Institute. The combination of several reinforcing mechanisms holds out considerable prospects for improving the strength of high performance ceramics.

A highly beneficial effect of this structural improvement is an increased mechanical stress tolerance. This also presents clear advantages in processing. While processing methods such as grinding and sawing inevitably cause surface cracks in conventional ceramics, a suitably upgraded ZrO_2 ceramic can be subjected to these procedures with practically no damage. In this way, even very thin components can be produced without cracking by normal surface grinding. For example, ZrO_2 sheets of only 80 micrometers thickness (less than the thickness of a razor blade) can be subjected to considerable elastic deformation without breaking.

Producing multiphase ceramic materials requires a basic knowledge of the compatibility of heterogeneous partners, of which the basic $Si_3 N_4$ materials strengthened with SiC whiskers are a good example. In practice, this compound is obtained by hot isostatic pressing whereby gas pressure is applied to the material at high temperatures. The conditions (temperature, pressure, composition of the gas phase) under which the compound material can be bonded without detriment to the matrix or the embedded fibers must be known. Knowledge of the thermodynamic properties of the system (such as formation enthalpies and entropies, mixture behavior in solid state solutions, etc.) makes it possible to correlate phase stability and production conditions. In practice the first thing to be established is the conditions under which the matrix is stable or disintegrates into silicon and nitrogen. There is a correlation between nitrogen (N_2) pressure and temperature: at a given temperature a fixed N_2 pressure is established. If this N_2 pressure is not provided from external sources, it builds up by disintegrating the Si_3N_4, or in other words the material itself. The nitrogen may however also cause the embedded SiC whiskers to shift. Computer-aided calculations indicate that N_2 is necessary in the gas phase because Si_3N_4 will otherwise be destroyed. When working at excess nitrogen pressure, the temperature can be raised considerably.

The external production temperature of the two-phase compound material is limited by the whiskers' reaction with nitrogen. The area in which basic Si_3N_4 compound materials reinforced with SiC whiskers can be produced is therefore a very narrow "window of equilibrium." The precise production conditions for such tailor-made materials can sometimes be obtained directly from thermodymanic calculations.

These aspects of ceramics are of great interest above all for producers of high performance components. Ceramics are of importance for engine and turbine construction, mainly because of their minimal specific weight combined with high strength and their high temperature and corrosion resistance. These properties must therefore be thoroughly investigated as well. Basically, there are four main causes for the failure of ceramic materials under considerable stress. These are rapid brittle fracture, material fatigue (sub-critical cracking), creep, and corrosion. Research on all four of these areas has begun in the new ceramics laboratories.

The statistical nature of strength is a very interesting question with great technical relevance. Rapid brittle fractures start from small faults occurring at random throughout the material. The largest of these faults is generally responsible for the crack. Since the largest faults of any geometrically similar test samples will not be the same size, the strength of these samples will never be the same either. However the failure or survival probability (reliability) of the sample can be established. Statistical theories can be used to demonstrate that there is a correlation between the distribution density function of the fault sizes and the probability of failure in a given sample. One consequence of this is that the probability of failure increases with the size of the components; i.e., the probability of finding large faults is far higher with large pieces than with small ones.

The quality of modern high performance ceramics is already so high that conventional methods are no longer adequate to establish their strength. Conventional strength testing of ceramics takes the form of bend tests on samples about the size of a match. With this test method the stresses are concentrated on the central part of the sample, the volume of the sample actually under stress is only a few cubic milimeters. The objective improvements achieved in production technology over the last few years mean that faults likely to lead to component failure are already so rare that it is practically impossible to detect them in such small volumes. The bend test therefore gives the impression of considerably higher strength values than can actually be achieved in a component.

As a consequence new test methods must be developed for high performance ceramic materials, whereby greater volumes can be tested than in the bend test. It has been proved that the faults relevant to failure, like their relative frequency, can vary widely from one component volume to another. These results are of great significance, since only when the type of fault relevant to failure is known can steps aimed at avoiding them be taken. Corrosion limits the usability of ceramic materials at very high temperatures. These limits can be assessed using thermodynamic principles in conjunction with kinetic models. In these simulation-based calculations, the speed at which the material erodes or corrodes is determined. It is assumed that the material is exposed to a hot, very fast flow of fuel gas (air mixture). This has the effect of immediately removing the material that emerges from the surface of the ceramic and thus no equilibrium gas pressure can build up. Nevertheless, the thermodynamically calculable equilibrium pressure determines the speed with which the material is broken down. With silicon carbide, the calculations show that even under conditions in which the hot gas does not react with the silicon carbide (the material thus only disintegrating as a result of spontaneous decay reactions), the damage to the material is still considerable even with low equilibrium pressures. With an equilibrium pressure of 10^{-5} bars (= 0.00001 atmospheres), damage is in the region of 1 gram per square centimeter

surface per day, meaning that surface areas can lose several millimeters of thickness every day.

Aeritalia To Develop Composite Materials Equipment for Italian Navy

3698M062 Rome FINMECCANICA NOTIZIE in Italian 30 Sep 88 p 9

[Text] MIKI of Erba, a company of the Aeritalia group, has been asked by Fincantieri to produce the protective paneling for two new "Animoso" class ships which are currently being built for the Italian Navy. MIKI has many years experience in the area of protective compounds, covering the full range of naval armament and equipment. Onboard installation will be carried out with a patented system based on the use of special bolts.

MIKI'S technical solutions are based on the use of special rolled sections, called Mirex panels, made with Kevlar fabric compacted with special thermosetting resins and coupled with layers of fired clay. The system offers high resistance to fracture and kinetic penetration with only a slight increase in overall weight.

INFN, EniChem To Develop Monocrystalline Materials

3698M088 Milan INDUSTRIA OGGI in Italian Nov 88 p 50

[Text] The National Institute of Nuclear Physics (INFN) and EniChem have signed an agreement which will enable EniChem to commercialize a new technology for the production of special monocrystalline materials (BGO) developed at INFN laboratories.

These monocrystals are used in the development of ionizing particle detectors for high-energy physics experiments and in the field of applied physics, for example in modern tomography.

The agreement—which emphasizes EniChem's interest in diversifying into high technology sectors and INFN's desire to transfer the products of its basic research to national industries—also forsees future cooperation in research on new optoelectronic materials related to this technology.

AEROSPACE, CIVIL AVIATION

EC: Proposal for Aerospace Industries Pilot Program Reviewed

3698M060 Rome AIR PRESS in Italian 4 Nov 88 p 2051

[Text] With a yearly sales volume exceeding 25,000 billion lire and a payroll of 200,000 people, the European aircraft industry wants greater operational certainty so it can improve its planning of future cooperative programs. This was affirmed by the members of the "Euromart" group of European manufacturers (Aeritalia, Aerospatiale, Dassault Breguet, British Aerospace, CASA, Dornier, Fokker, MBB, and SABCA) in a report submitted to the EC Commission. Euromart suggested a number of policies to be pursued if the European aircraft industry is to effectively face growing competition from the United States and Japan, as well as from the newly-industrialized countries such as Brazil, Indonesia, and the PRC.

The EC executive committee emphasized the need to broadly strengthen the technological basis of this sector through more effective cooperation in precompetitive research. Furthermore, the European aircraft industry should utilize external research institutes and universities to a greater extent and promote the exchange of information among researchers in single sector companies.

The EC Commission has already suggested launching a 2-year pilot program based on existing technology but aimed at selecting the initiatives for long-term development. These initiatives will be designed to apply advanced technology to increase safety and save energy, as well as to curb the negative environmental impact caused by aircraft activities.

Euromat Study Reveals Bleak Outlook for EC Industry

36980079b Paris AFP SCIENCES in French 10 Nov 88 p 16

[Text] The commercial successes achieved by the European aeronautical industry over the past 20 years may well be jeopardized by the tremendous technological effort undertaken by the United States to reinforce its dominant position, say the EEC's main manufacturers in a report published on 3 November.

To stay competitive, European industry must invest a great deal more than the 370 million ECU's (about $429 million) it currently devotes annually to research and technology (excluding development), according to the report, which was commissioned by the European Commission in Brussels. The manufacturers will also have to better coordinate their research at the Community level.

In the light of this Euromat report, the EEC Commission proposed to the 12 last summer that they devote 60 million ECU's ($69 million) to a 2-year pilot research program. The report also stresses the threat being posed to European industry by the appearance of new competitors such as Brazil, Indonesia, and China, where aircraft manufacturers are heavily subsidized by their governments.

The EEC's aeronautical industry employs 200,000 people and has an annual turnover of 16 billion ECU's ($18.6 billion). It currently has about 26 percent of the world market, both civilian and military, compared to only 5 percent at the start of the 1970's. The civilian market is destined to grow very rapidly, since passenger traffic, which has already doubled over the past decade, is expected to double again over the next 10 years.

Nine European manufacturers participated in drawing up the Euromat report: Aeritalia (Italy), AEROSPATIALE [National Industrial Aerospace Company] and Marcel Dassault Aircraft-Breguet Aviation (France), British Aerospace (Great Britain), Aeronautical Construction Company (Spain), Dornier and Messerschmitt-Boelkow-Blohm (FRG), SABCA [Belgian Aeronautical Construction Company] (Belgium), and Fokker Aircraft (the Netherlands).

Japanese, European Space Agencies Sign Cooperation Agreement

3698M050 Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 487, 16 Sep 88 p 15

[Text] A new cooperation agreement has recently been signed between the Japanese space agency NASDA and the European Space Agency (ESA). Over the next 3 years NASDA will import European rocket components with an approximate total value of 100 million yen. These items, which include relay and connecting components, will be mounted on the Japanese H-2 Rocket, now being developed and scheduled for its first launch in 1992. The ESA research center will be responsible for quality control of the components that are to be sent to Japan.

Head of Airbus Industrie Supervisory Board Appointed

36980089a Duesseldorf HANDELSBLATT in German 21 Nov 88 p 11

[Article: "Hans Friderichs Becomes Chairman of Supervisory Board"; first paragraph is HANDELSBLATT introduction]

[Text] Former Federal Minister for Economics and ex-spokesman for the board of directors of the Dresden Bank AG, Dr Hans Friderichs (57) will succeed late Bavarian Minister-President Franz-Josef Strauss as head of the supervisory board of the European consortium Airbus Industrie (Toulouse/Paris). That decision was made at the London meeting of the four ministers or secretaries of state of the consortium's member countries who are responsible for Airbus.

British Secretary of State for Trade & Industry Lord Young announced the decision in London. The ministers "welcomed" this appointment. Traditionally the position of head of the Airbus supervisory board is not held by France which considers itself the heart and driving force of Airbus development. However, following tradition, France is still entitled to the position of chairman of the board of directors, held for 10 years by Bernard Lathiere and now occupied by Jean Pierson. Also mentioned as a candidate for head of the Airbus supervisory board was former British Minister of Foreign Affairs and NATO General Secretary Lord Carrington—an ardent and proven European. Before the takeover of actual control of German Airbus partner Messerschmitt-Boelkow-Blohm (MBB) by Daimler-Benz AG, MBB board chairman Hanns-Arnt Vogels was also discussed as a possible candidate for chairman of the supervisory board. Like the French partner Aerospatiale, MBB holds a 37.9-percent share of the Airbus consortium which is structured under French law. British Aerospace holds 20 percent, and the remaining 4.2 percent is held by the Spanish manufacturer Casa.

Vogels will be a member of the Airbus supervisory board which is to be reduced from 16 to five members. In addition to chairman Friderichs, the chairmen of the boards of directors or presidents of Aerospatiale, British Aerospace, and Casa have seats and votes. As Lord Young stated at London's Lancaster House, the ministers are retaining their goal of developing a new corporate structure for Airbus by 1 Jan. of next year. The plan is to transform Airbus Industrie into an efficient and financially strong private enterprise.

As a result of the goals adopted, the rather loosely structured group of firms is to be restructured into a tight, highly efficient company. The clear reduction in the size of the board of directors is one of the means to these goals. In the future, Airbus Industrie management is to consist of six or seven members. Of critical significance in this regard is the appointment of a new finance director who, according to the declared intent of the governments, will be provided with all the financial authority necessary to improve the business and financial efficiency of Airbus Systems. Appointment of a new finance director at the London meeting of ministers had been generally anticipated. The German side is making it quite clear that it wants to fill this post with a German manager.

The ministers acknowledged in London that the discussions with U.S. aircraft manufacturer McDonnell Douglas concerning possible cooperation were recently discontinued. However, they continue to insist that such cooperation could definitely be useful. They contend that these contacts could be resumed at any time if they should prove to be "promising." McDonnell representatives recently made it clear to this newspaper that "nothing would come" of these cooperation negotiations. The basic reason for this is the American requirement that Airbus drop its planned construction of long-range models A-330 and A-340 in favor of a joint long-range project based on McDonnell's model MD-11.

For its part, Airbus had sought cooperation with McDonnell primarily for two reasons: First, a second Airbus assembly line in America in addition to the one in Toulouse originally attracted the attention of Airbus in view of the weakness of the dollar. Also, the Europeans wanted, as an "American" manufacturer and employer, to deprive the market leader Boeing of the argument advanced primarily by Boeing that Airbus was competing with them using taxpayers' money. The basic reason

for the failure of the negotiations is the fact that the offerings of the two manufacturers are too similar.

Arianespace First Board Meeting in Kourou

36980079c Paris AFP SCIENCES in French
10 Nov 88 pp 12-13

[Text] Kourou—For the first time since the company was founded on 16 March 1980, the board of directors of Arianespace held its meeting in Kourou on 8 November. At the conclusion of the meeting, company chairman Frederic d'Allest confirmed before the cameras and microphones of RFO [French Overseas Radio and Television] that Arianespace's shares would be listed on the stock exchange. Arianespace's capital stock currently totals 270 million francs.

No specific date for the operation was announced, however, since the matter must be examined at the next meeting by the company's board of directors, which will be held in January 1989. "We are in a phase of study, and no decision has yet been made. If our board of directors and the various authorities involved give their consent at the start of next year, the operation could take place in the middle of 1989," said D'Allest.

Thirty-five persons delegated by the 50 stockholders representing the scientific, technical, financial, and political capacity of 11 European countries (the FRG, Denmark, Spain, France, Great Britain, Ireland, the Netherlands, Sweden, and Switzerland [9 countries named as published]) and the company's management took advantage of their stay at the site of the Guyana Space Center to visit all the facilities and the construction sites for the third launch pad, which is intended for the big Ariane-5's of the future that will be used around 1995 to launch space station components or the Hermes European aerospace plane.

In the large assembly building, the members of the board of directors were also able to view the next Ariane-3 (flight V-27), the third stage of which had been installed the day before. This Ariane-3 is scheduled to place both Luxembourg's ASTRA direct television satellite and the British Skynet-4B military satellite in geostationary orbit during a single flight on 9 December. Preparations for that launch are proceeding "in a completely normal fashion."

Hermes: Composite Materials Furnace To Operate in 1989

36980079d Paris AFP SCIENCES in French
27 Oct 88 p 25

[Text] Paris—At the end of next year, a furnace for firing large composite materials components for the Hermes aerospace plane will be in operation at the Aquitaine plant owned by the SEP (European Propulsion Company) in Le Haillan near Bordeaux.

The furnace will be used to fire large components such as the elevons (control surfaces combining the functions of ailerons and elevators) for the European aerospace plane planned for 1997 and beyond. The temperature of the components in question will rise to between 1,200 and 1,300 degrees during the aerospace plane's reentry phase—that is, at the point where, during the plunge back to earth, the layers of air become increasingly dense.

In the Hermes program, the SEP and AEROSPATIALE [National Industrial Aerospace Company] were made responsible for building the airplane's "hot parts." AEROSPATIALE is responsible for the nose and the leading edge of Hermes' short delta wings, while the SEP is responsible for the heat shield components of the plane's underside and its elevons.

The furnace at Le Haillan, which will cost several tens of millions of francs, will be 6.5 meters long with an overall diameter of 4.3 meters and have a usable internal space measuring 2.8 meters in length and 2.5 meters in diameter. Notification that it had been given the contract to build the furnace was sent to the SEP within the past few weeks by the CNES [National Space Studies Center], which is responsible for carrying out the Hermes program on behalf of the ESA [European Space Agency].

FRG Firm MAN Produces Ariane 5 Booster

36980084a Stuttgart FLUG REVU E in German
Nov 88 p 92

[Article by Michael Schaefer: "Space Technology: Booster for Ariane 5"]

[Text] Bavaria Participates in Space Technology: The MAN Company in the Town of Augsburg Is Building Boosters for the Ariane 5.

On September 30, a new building was dedicated on the premises of MAN Technologie GmbH: production facilities for the outer casings of Ariane 5 solid rocket boosters. The boosters are to be used to lift the heaviest satellite transport vehicle in the Ariane series on its maiden flight in 1995, and later to carry the space glider Hermes into space.

The Ariane 5 boosters are 25 meters long and 3.1 meters in diameter. The 230 metric tons of fuel which they contain burn for 125 seconds after booster ignition, and deliver 80 percent of the initial thrust: 2 x 650 tons.

The development of the Ariane 5 program will cost the participating countries in Europe around DM 4.5 billion. According to the European Space Agency (ESA), DM 490 million of this amount is to be earmarked for development of the boosters and construction of the MAN production facilities in Augsburg up to 1995. The

booster production building, which is 18 meters tall and covers 5400 square meters, has already cost DM 25 million, and an additional DM 110 million were needed to outfit the facility with high-precision machine tools.

The heart of the facility is a press rolling machine with counter-rollers. This CNC-controlled, 550-metric-ton precision rolling machine will be used to shape the tubular booster segments.

The semifinished steel tubes produced—one meter high, 3.1 meters in diameter with a wall thickness of 58 mm—are first turned to a wall thickness of 40 mm. Then the four pairs of rollers in the press rolling machine roll the cylinders down to a wall thickness of only 8.2 mm, which causes their height to increase by 2.5 meters.

After rolling, the mating parts of the tongue-and-groove joint are machined into the ends of the segments whose wall thickness has been left at 40 mm. Subsequent heat treatment increases the tensile strength of the steel to 1500 N per square meter—the walls of the boosters, designed to withstand an operating pressure of 65 bar, would not burst until reaching a pressure of 90 bar.

The boosters used with the American Space Shuttles are apparently manufactured according to a very similar process which to date has been kept highly classified. An engineer at MAN said, "Judging by the machining marks on the Shuttle boosters, the Americans are using exactly the same methods we are."

Spain To Participate in Helios Satellite Program

36980079a Paris AFP SCIENCES in French 10 Nov 88 p 15

[Text] In Luxembourg on 9 November, Spain signed the agreement under which it will join France and Italy in building a military observation satellite— Helios—for launching in the 1990's. Madrid will contribute 7 percent (15 billion pesetas) to this French-designed program, whose main mission will be surveillance of the Mediterranean region.

Spanish Minister of Defense Narcis Serra, his French counterpart Jean-Pierre Chevenement, and Italian Secretary of State Giuseppe Pisanu initialed the agreement as they were attending a meeting by the Independent European Program Group (GEIP). Italy, which will contribute nearly 14 percent, joined the Helios program back in September 1987. The program was started by France in 1985.

Spain is benefiting from industrial countertrade equivalent to 100 percent of its financial participation. A satellite earth station identical to those already planned for France and Italy will be built on Spanish territory by a consortium made up of the INISEL (Spain) and Selenia (Italy) firms.

BIOTECHNOLOGY

FRG's Max Planck Institute Proposes Plant Breeding Project

36980034c Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 27 Sep 88 p 8

[Article by T.N.: "Better Plant Breeding With New Gene Technology"]

[Excerpt] Frankfurt—New methods of gene technology have become an important instrument in exploring basic phenomena in plant biology. By using methods of genetic technology in plant breeding, even conventional cultivation methods, which are burdened with many imponderables, are considerably improved. With their help it will be possible in the future to exchange certain hereditary information in a more deliberate manner and to shorten the growing period considerably. They are thus regarded as an important future aid in practical plant breeding by the breeding enterprises as well. These methods can enable plants to produce certain valuable content materials in a more deliberate way than before.

Beyond that, there is indication of new attempts to grow plants that can also better utilize the nutrients present in the ground and in the air. The particularly for individual plants so distinct characteristic of using atmospheric nitrogen for food could be transferred to many useful plants, for example. This means that less fertilizer would then need to be used. That would not only reduce the immediate burden on the environment, but a significant energy saving for fertilizer production could also be achieved. By means of an equally deliberate selectively bred resistance to pests in plants, a reduction in pesticide expenditure might also be possible.

The new methods have already been studied and tested in numerous laboratory and greenhouse experiments. The results and experience gathered from them are so encouraging that it is now believed possible to initiate correspondingly designed experiments in the fields. In order to obtain additional information about the behavior and stability of the genetic changes, as well as for the purpose of studying certain biological phenomena, it is necessary to cultivate genetically altered plants under real (open field) growing conditions. Such experiments with genetically altered plants in the open have already been or are being carried out at present in many places in the world. In the FRG each individual case must first be reviewed before the start of the experiment by the Central Commission for Biological Safety (ZKBS), as to whether and to what extent it could pose danger to humans, animals, or the environment in releasing a new breed. The permit for the experiment depends on the result of this evaluation.

The Max-Planck Institute for Breeding Research in Cologne has applied to the Central Commission for

Biological Safety for permission to undertake an open-field experiment, in order to remain scientifically competitive in this area. In this experiment the genetic phenomenon of the so-called "jumping gene" will be studied in petunias, which here in Germany are grown as non-hardy ornamentals. "Jumping genes" occur naturally in the genome of many organisms. Through them the hereditary information of plants is altered. In order to undertake basic research on this phenomenon, petunias will be used which by methods of genetic technology have been "crossed" with a defined color gene from corn. The blossoms from these genetically altered petunias are not, as usual, blue/red, but salmon-colored and thus "marked." Because of the "jumping gene" there will again be changes in the coloration of some blooms. This study is to be carried out in Cologne. In the opinion of scientists from the Max-Planck Institute, it can be assumed, based on the previous experience, that no dangers are associated with undertaking this cultivation in the open.

COMPUTERS

EUREKA Software Development Consortium Formed

36980088b Duesseldorf HANDELSBLATT in German 24 Nov 88 p 14

[Article: "First Software Factory To Be Tested in 1992"; first paragraph is HANDELSBLATT introduction]

[Text] A Europe-wide research project headquartered in Berlin will run 10 years. According to experts, because in the next few years demand for software will far exceed currently identifiable development capacity, great importance is attached to tools to increase the productivity of software developers. Therefore, in the framework of the ESF EUREKA Software Factory Project, engineer-level production is to be accelerated and worldwide standards established.

To that end, 13 research and industry partners from five European countries (the Federal Republic of Germany, France, the United Kingdom, Sweden, and Norway) have decided to form a consortium. The headquarters established in Berlin for the project, which has just been announced, will coordinate and direct the activities. DM750 million are available to the 10-year project, which will be distributed over 24 company locations in Europe and will employ an average of 240 specialists. The initiative's primary goal is reportedly to enhance the competitiveness of the European software industry.

The software industry which, according to data from AEG board member Dr Peter Stehle, in 1987 alone increased its sales in the FRG by 18 percent to DM18.6 billion thus now is not only one of the strongest economic growth sectors but is also increasingly assuming a role as a driving force for other branches, such as plant construction, power and fuel supply, and the automotive industry. In 1988 the volume of the German data processing market is expected to reach approximately DM40 billion, almost half of it in the software and service area. Beginning in 1990 software's share will exceed that of hardware, and as early as 1992 will constitute more than 60 percent of the total volume.

However—lest software become a bottleneck to growth—the productivity of software developers must be increased significantly. In the words of Stehle, this can only be accomplished with new technologies; therefore, the "leap from software handicraft to the software factory is long overdue."

By this he means computer-aided industrial software development, i.e., special programs—software tools, in other words—which support the division of labor in software development. Similar to the situation in other fields of engineering, where, for example, nuts and engines are reusable components for several applications, ESF is to create both components and standards for the software market. In this, ESF intends to keep in mind all software applications—commercial and industrial systems as well as software for telecommunications and the science sector. According to the ESF timetable, the first software factory will already be "in the test phase as a product with user applications" by April 1992.

In addition to the financial commitment of the individual consortium members—the four German partners are AEG's GEI systems and software company, Nixdorf, and Softlab, as well as the University of Dortmund—the ESF project will be funded by all five participating countries. Among the 214 current EUREKA projects, ESF ranks fourth in terms of volume.

Nixdorf Forced To Adopt Austerity Program

36200090x Hamburg DER SPIEGEL in German 2 Jan 89 pp 78, 79

[Text] The era of the Nixdorf Computer's AG fat years is past, and the great clean-up has begun. Board chairman Luft intends to shed 5,000 jobs.

Klaus Luft is not the man to quickly accept defeat.

To be sure, all the news arriving at the desk of computer manufacturer Nixdorf's chief in late summer and fall indicated a definite deterioration. Still, Luft continueds to radiate optimism—at least to the outside. As late as November last he was ready to bet that the last weeks of the old year would yield a new push for orders.

The reality was very different. For Nixford (31,000 employees, DM5 billion turnover), business at the end of the year turned out to be more sparse than for many years. It is becoming increasingly evident that the long string of successes making Nixdorf the model enterprise of the German computer industry has finally torn.

Not until 1986 did board chairman Luft (47) succeed Heinz Nixdorf, the legendary founder of the firm. Just before Christmas he saw no other way out: "We need to let 5,000 people go," he announced.

Mass dismissals at Nixdorf? The report on rising employee figures used to be one of the most attractive annual features presented at the general meeting. Luft had hired thousands of staff until mid-1988. He intended to drive the firm forward with a program unique even in the growth oriented computer industry. He claimed that "we will double our turnover within 4 years."

In September several indicated that Luft would have to cut back. Various factors had joined together: Competition on the computer market was definitely stiffer; the cheap U.S.dollar benefited imports from the leading U.S. manufacturers and the Far East; traditional Nixdorf customers from the medium layer of business and the financial institutions were more restrained in their orders. Finance chief Sven Kado complained that "our profit margins have narrowed radically."

By now the management was compelled to acknowledge that debts had seriously increased in past months. Finance chief Kado also intimated that unexpected research costs in the amount of (additional) DM200 million were adversely affecting the annual result.

The bad news from Paderborn jolted the securities departments at the banks. Profit estimates, set much too high in accordance with the official reports issued by Nixdorf, needed to be corrected downward. The Dresdner Bank, for example, informed its customers that no more than DM5 earnings per share were to be expected from Nixdorf instead of the earlier assumption of DM18.

By now it is indeed possible that Luft might omit any dividend for 1988. The Nixdorf chief will need that money. Those familiar with the firm's business think that Nixdorf may make a loss in 1989.

At the last moment Nixdorf tried to slightly improve the figures by freezing all hiring and decreeing an austerity program for general andtravel expenses and for building improvements. Lots and buildings, earlier acquired on generous terms, were to be rapidly liquidated for cash.

Nor is that going to be the end of it. The board will have to reconsider some costly experiments. These include:

- Doing business in the United States. This, Luft's pet project as already swallowed several hundred million D-marks, and no end of the lean years in in sight;
- The attempt at doing business with digital telephone installations for enterprises. On this hotly disputed market—dominated by Siemens—, Nixdorf is losing money on every order;
- The attempt to sell Nixdorf computers for use in industrial production also. In this field the newcomer from Paderborn was able to record only few initial successes (for example at Volkswagen) only by substantial price cuts and the losses resulting therefrom.

The poor figures have now aroused the Nixdorf supervisory board. At a meeting in late November, Luft tried to calm dissatisfaction by pointing to general cost cutting programs.

The supervisors were particularly interested in the Nixdorf management's answer to the question of the products it was looking to for extricating it from the current difficulties. One supervisor complained about the high cost of research and development. This accounts for more than DM400 million annually, and it is, therefore, hard to understand why the firm had not been able to offer even one of the urgently needed computer innovations.

The answers were unsatisfactory. As one supervisor put it, "the management will very quickly have to come up with something new. Everything now depends on the results offered by R&D."

That cannot be much. Nixdorf has never developed its own computers. So far the Paderborn firm has bought in almost all innovations from other producers.

Heinz Nixdorf's successor knows little of technical innovation. Luft earned his spurs as financial and marketing manager and has been responsible for production for some time.

In the latter capacity he is now trying to set an example of austerity. Recently he told a staff member: "If you wish to hire a new man, you will first have to fire five others."

DEFENSE INDUSTRIES

Technical Features of AMX 2-Seat Fighter Aircraft

36980060 Rome RIVISTA AERONAUTICA in Italian Sep-Oct 88 pp 38-45

[Excerpts] The technical development and production of the AMX under a program which was the subject of an article in our preceding issue have involved the Italian and Brazilian industries concerned in a closely integrated form of cooperation to satisfy the requirements of the two countries' respective Air Forces. Thus, before entering upon a technical description of the plane, a few details are in order concerning this industrial agreement. [Passage omitted]

The AMX 2-Seater

Development of the AMX 2-seat version was begun in 1986 by the three companies [Aeritalia, Aermacchi, Embraer]. Its object was to derive from the AMX a version that could be used for advanced training and also converted operationally for use on special missions. The

plane would also be an ideal substitute for the 60th Air Wing's G.91T which, by the end of the 1980's, would begin reaching the end of its operational life. Hence, the Italian Air Force's interest in this plane, and its order for 51 units, the first of which is to fly during the second half of 1989. The Brazilian Air Force ordered 14 of the planes. The first three AMX 2-seaters (two Italian and one Brazilian) were made part of the first production lot.

It is interesting to note that the operational capabilities of the single-seat version of this plane remain practically unchanged in the 2-seat version. The two versions, in fact, have many components in common, and this facilitates the servicing and maintenance of AMX single-seaters and 2-seaters within the same flight line, free of any particular difficulty. Space for the rear cockpit was made by reducing the volume of the internal fuel tanks. This cockpit is equipped with, among other things, a Ferranti International Signal MED 2067 video monitor display, which, with its high-resolution imaging and low energy consumption, can be used as an HUD [head-up display] and is compatible with night-vision systems.

Technical Description

The AMX is a single-engined single-seater optimized for close battlefield support and tactical reconnaissance, and is also capable of carrying out interdiction and counter-air missions. The 2-seat version, on the other hand, is intended for advanced training and operational conversion, and for special missions where the presence of a second crew-member is essential. The plane's architecture was designed to provide a substantial survival capability in the event of malfunctions or damage sustained in combat. The primary flight control system controls the plane in three axes and, as specified in the "military requirements," provides the AMX with sufficient maneuvering capability effective for the first hydraulic or electrical malfunction. Even in the event of a second malfunction of this type, the plane can return to its base, owing to the duplication and separation of the control lines and power systems, and to provision for manual control and emergency fallback for pitch and roll.

The wing is cantilevered at a medium height, has a moderate sweepback (31 degrees at the leading edge and 27 degrees 30 minutes at one fourth the chord length), a high thickness ratio (12 percent of the chord), and an aspect ratio of 3.75 to 1. Its structure is of the twist-resistant wing spar box type, with three spars and stressed skin construction for integral stiffening. Each half-wing is attached to the fuselage at three points, each corresponding with one of its three spars. The slats are split-hinged and extend along almost the entire length of the leading edge. The flaps are of the double-slotted Fowler type, are also split, and occupy approximately two thirds of the wing trailing edge. Mounted forward of the flaps, on the top surface of each half-wing, is a pair of spoilers that are used both as spoilers and as air brakes. The ailerons have a reduced area, are devoid of balancing tabs, are hydraulically operated with provision for manual inversion, and occupy the outer section of the trailing edge. The dualled aileron and spoiler systems provides lateral control even at low speeds, owing to the large area of the flaps, and satisfies the minimal-vulnerability requirement. In the event of a single hydraulic malfunction, the system is configured so that only one pair of spoilers is lost. If both hydraulic lines fail, the plane can be controlled manually by operating the ailerons. A spring-loaded system provides artificial sensing, while trimming and roll-damping devices provide optimal flight control capabilities throughout the plane's rated flight envelope. The AMX's wing design is governed by strict criteria of simplicity and robustness, but also draws abundantly on the most advanced technologies and on the experience already gained with the Tornado. The more pronounced sweep angle between the leading edge and trailing edge increases the efficiency of the flaps and control surfaces, while the high-wing configuration, already a feature of the MB-340 design, enables the attachment of loads, even of considerable bulk, to the wing pylons.

The fuselage has a semi-monocoque structure of circular cross-section. The forward section provides the housings for the plane's avionics, its various items of equipment, its M61 cannon (replaced by two DEFA's in the Brazilian planes) and respective ammunition, the forward landing gear, and the cockpit. The latter is positioned prominently and thus provides good forward (18 degrees) and lateral visibility, a very desirable feature for air-to-ground missions as well as air combat at close quarters. Other avionics components and electrical and reconnaissance equipment are located below and behind the cockpit. The mid-section of the plane houses the air intakes, the main landing gear, and the engine bay. The air intakes are of the fixed-geometry type, made of composite materials, and are designed to ensure an adequate flow of air, hence optimum engine efficiency, throughout the flight envelope. Moreover, their location on the sides of the fuselage behind the cockpit minimizes the risk of ingesting birds or other foreign objects and unclutters the pilot's rear and lateral angles of visibility. The aft section supports the tail assembly and is completely removable to facilitate the quick removal of the engine. The tail assembly is of the traditional type and features completely mobile variable-incidence stabilizers. The latter characteristic is inherited from the Tornado. The stabilizers are equipped with balancers and their rather low position with respect to the half-wings helps minimize the effects of downwash, hence provides good stability even at high angles of incidence. The stabilizer-balancer complex provides good longitudinal control of the plane. Two separate mechanical transmission systems permit the longitudinal control to act upon the two balancers, which are operated by two hydraulic actuators, powered by independent hydraulic circuits. The mechanical transmission lines can transmit manual-control commands and are equipped with a release system that ensures maneuvering capability should one of the lines become inoperative owing to a malfunction. A hydraulic spring provides the controls with artificial

sensing, while, in an emergency, a signal and a separate electrical line start up one of the electric motors that actuate the stabilizers.

The sweptback vertical empennage consists of the fin and rudder. The fin is made of composite materials by Aeritalia, whose experience in this field goes back many years and is now very substantial. The fin spar box consists of a multi-spar monolithic structure made of carbon-fiber-reinforced epoxy resin laminates. The mid-section of the structure consists of two panels, which give the surface the necessary aerodynamic profile, and five spars. The only metallic components are the aluminum alloy points of attachment to the fuselage, and two ribs. The components are assembled in an autoclave in a single work cycle. This expedient enables the bonding of the components without the use of metallic junctions and results in a weight reduction of 20 percent and a saving in machining costs. The leading edge of the tailplane is of one-piece construction, made of Kevlar, and has excellent strength characteristics. For the rudder, as well as for the stabilizer balancers, a carbon-fiber beehive structure was used. Static tests run on these surfaces amply demonstrated the characteristics of robustness required of them and confirmed their advantage over traditional metallic materials from the standpoint of economy of maintenance. Steering is controlled by a signal sent by the pilot via a mechanical link to a two-cylinder hydraulic actuator.

The landing gear was developed by Messier-Hispano-Bugatti and built in Italy by Magnaghi and by ERAM. It is of the hydraulically-operated retractable tricycle type. The nose-gear is steerable within a range of 60 degrees, forward retractable, self-centering, and equipped with an antishimmy device. The front tire is an 18 x 5.5-8. The two main gears are forward retractable, and are equipped with 670 x 210-12 tires inflated to 9.65 atmospheres, with a normal hydraulic and emergency braking system, and an antiskid system. Each gear of the undercarriage is equipped with oleopneumatic dampers. A hydraulic-electric system operates the landing gear, which in the event of a complete failure is actuated by an emergency system. Moreover, the plane has no braking chute; it is equipped with an underbelly arrester hook for engaging an emergency barrier.

The power plant is a Rolls-Royce Spey Mk 807 dual-shaft turbofan without afterburner, with a rated thrust of 5,007 kg (49.1 kN). The Spey is 2.45 m long, weighs 1,114 kg, and has a bypass ratio of 0.93 to 1 and a compression ratio of 16.3 to 1 (equivalent to 91.6 kg of air per second). This turbofan has a modular design and is being built by a consortium consisting of Fiat Aviazione (prime contractor), Piaggio, Alfa Romeo Avio, and the Brazilian firm CELMA. The Spey—a variant of which has an afterburner—presently powers numerous military and civil aviation planes throughout the world and was chosen because of its low specific consumption ratings and its particular characteristics of reliability and robustness. The extensive experience Rolls-Royce has acquired with this engine has yielded particularly high values of MTBF [Mean Time Between Failures] and TBO [Time Between Overhauls] that are clearly advantageous in terms of the planning of maintenance activities.

Integrated in the Spey are a gearbox, a low-pressure fuel pump, and a Fiat Aviazione FA 150 Argo dual-shaft 150-hp APU [auxiliary power unit]. This compact modular APU was designed to satisfy the high-operational-flexibility requirements of new generation secondary power systems and will also be installed on planes currently under development, such as the EFA [European Fighter Plane]. The APU provides the turbofan with a self-starting capability, without the need for external energy sources, and this enables the AMX to operate even from forward-based fields devoid of support facilities. The FA 150 Argo also powers the conditioning system and enables the preflight checking of the principal onboard systems with engines off, thus yielding a substantial advantage in terms of the plane's readiness for takeoff.

Fuel is carried in 9 self-sealing tanks in the fuselage and 2 wing-integrated tanks. In addition, two sizes of detachable auxiliary tanks, 1,100 and 580 liters respectively, can be suspended from the wing pylons. The choice of integrated and self-sealing tanks was designed to satisfy various requirements as to vulnerability and protection. A single-point attachment port is provided within easy manual reach from the ground for quick refueling and emptying of the tanks, including the external ones. In addition, other filler openings enable gravity-feed refueling. Plans also call for the installation of a lateral probe on the AMX for air refueling from planes equipped with the buddy-buddy pod or from tanker planes.

The pilot's seat is a Martin Baker Mk 10L, equally ejectable at zero velocity and altitude, and in flight at speeds in excess of 560 knots and altitudes of over 50,000 feet. To improve visibility, the windshield and the canopy, which is hinged on the starboard side of the cockpit, have been molded as a single piece. The cockpit is very comfortable and is pressurized and air-conditioned. The design of the cockpit embodies, in addition to the most advanced ergonomic principles, the new HOTAS [Hands on Throttle and Stick] concept, aimed at minimizing the psycho-physical demand on the pilot and thus increasing his concentration during some phases of the flight. A Microtecnica ECS [environmental control system] pressurizes and air-conditions the cockpit, controls the temperature of the avionics and reconnaissance equipment compartments, de-ices the air intakes, defrosts the windshield, and inflates the pilot's anti-g suit. The dually-redundant hydraulic systems are powered by the turbofan's gearbox and operate at a pressure of 207 atmospheres. They in turn power the main controls, the flaps, spoilers, undercarriage, brakes and wheel-steering system, antiskid system, and M61 cannon system. The primary electrical system—alternating current at 115/220 volts and a fixed frequency of 400 Hz—is powered by two 30-kVA generators and is equipped

with two transformer-rectifiers for conversion to direct current at 28 volts. Emergency power is provided by two 36-ampere-hour nickel-cadmium batteries capable of powering the essential systems in the event of failure of the primary and secondary systems. The engine can be started up by the FA 150 Argo APU.

The AMX's fixed armament consists of a General Electric 20-mm M61A1 Vulcan cannon, manufactured under license in Italy by Breda, and installed in the lower portside section of the nose. In the Brazilian planes, this weapon, which has a theoretical firing rate of 4,000 rounds per minute, is replaced by two 30-mm DEFA 554 cannons. The plane has 7 attachment points for external loads—totaling 3,800 kg in all: 1 under the belly, 4 inside and outside the wing pylons, and 2 under the wing tips. The latter two are designed to take launch rails for air-to-air missiles of the AIM-9L Sidewinder type (MAA-1 Piranha on FAB planes). The underbelly attachment point and the two points inside the pylons have a capacity of 907 kg each, while the two points outside the pylons can support 454 kg each. These attachment points can be equipped with racks of various types (single-, double-, or three-track) depending on the requirements, or with detachable 560- and 1,100-liter auxiliary tanks. A buddy-buddy pod for air refueling can also be attached to the underbelly point. For close-support, counter-air, and interdiction missions, bombs of various types (Mk 82, Mk 83 and Mk 84 free-drop and delayed-action, and BL 755 fragmentation bombs), and pods for rockets and air-to-surface missiles such as the AGM-65 Maverick, can be used. The previously cited antiship variant equipped with multimode radar, on the other hand, can also use air-to-surface missiles. The AMX's pylon attachment points are also compatible with the new Skyshark submunitions dispenser developed by the CASMU consortium formed by Aeritalia and SNIA-BPD. The dispenser, which is offered in the glider and self-powered variants, would enable the AMX to hit heavily protected and extended-area targets, such as air bases, from a stand-off position. The AMX's reconnaissance system consists of alternative palletized assemblies which can be installed in a fuselage compartment located behind the cockpit, and of an optronics pod hooked on to the underbelly attachment point. The four assemblies enable panoramic, TV, aero-photogrammetric, and infrared imaging and can be installed without in the least impairing the plane's operating capabilities.

Particular attention was given in the design to facilitating the accessibility of onboard equipment, so as to simplify and speed up maintenance, preflight, and turnaround operations. For the most part, the systems are housed in cubicles within easy manual reach (not more than 1.7 m above the floor at most), and is easily accessible by way of some 200 movable panels that permit the carrying out of 95 percent of the required inspections without having to remove a single component. The equipment units are grouped homogeneously to avoid interference among the specialists at work in and around the plane.

The AMX's equipment, like the Tornado's, is self-testing and the maintenance it undergoes is predominantly of the on-condition type. Through extensive use of BITE [built-in test equipment] and the presence of a suitably centralized panel, the plane's various onboard systems can be checked, and malfunctions detected and visually displayed. The inspection process is thus speeded up and the time the planes are inoperative owing to maintenance requirements is reduced. On-line maintenance (1st and 2nd levels), scheduled and unscheduled, requires less than 12 man-hours per hour of flight. The cockpit and avionics equipment are kept air conditioned by the APU during inspection by the technical personnel as well. Preflight checks of the plane and its avionics can be carried out by a single specialist in less than 10 minutes. Turnaround readying of the plane, on the other hand, requires a full 10 minutes and the work of two specialists. As for readiness and takeoff times, it can be said that, over the long term, an AMX plane could guarantee an extremely short reaction time except for minor maintenance requirements. With onboard equipment turned on in standby mode, the plane can be kept at the peak of its operational performance capabilities, ready for takeoff, for several hours. With its systems not activated, the plane can take off under scramble conditions in a very few minutes.

AMX Characteristics and Performance Ratings

Dimensions and Areas

Wing span (with AIM-9L missiles installed)	9.97 m
Wing span (without missiles and launch rails)	8.874 m
Aspect ratio	3.75
Taper ratio	0.5
Overall length	13.23 m
Fuselage length	12.55 m
Overall height	4.55 m
Tailplane span	5.20 m
Track	4.75 m
Airfoil	21.00 m^2

Weights

Operating empty weight	6,700 kg
Maximum external weight	3,800 kg
Takeoff weight in "clean" configuration	9,600 kg
Typical takeoff weight	10,750 kg
Maximum permissible takeoff weight	12,500 kg
Normal landing weight	7,000 kg
Operational wing loading ("clean" configuration)	385 kg/m^2
Maximum wing loading	595.2 kg/m^2

Performance ratings

Maximum speed in level flight	0,86 mach
Operational ceiling	13,000 m
Takeoff run at sea level (at 10,750 kg TOW)	750 m
Minimum steering radius	11.00 m

AMX Characteristics and Performance Ratings

Hi-lo-hi profile radius of action with 907 kg external load	890 km
Lo-lo-lo profile radius of action with 907 kg external load	555 km
Hi-lo-hi profile radius of action with 2,720 kg external load	520 km
Lo-lo-lo profile radius of action with 2,720 kg external load	370 km
Transfer range with 907 kg external load and two 580-liter auxiliary fuel tanks	3,150 km
g-limit	plus 8/minus 4

[Boxed insert p 43]

Avionics

The AMX's avionics are particularly sophisticated as compared to those of other planes in its class. Their design embodies the principles of redundancy and self-testing to enable the plane to complete its mission and return to its base despite malfunctions or serious damage it may have incurred. Particular attention was devoted to navigational and aiming aids, which are extremely accurate and provide the AMX with all-weather capability.

The AMX's navigational system uses two independent main computers linked to the sensors and displays by two digital data buses which provide a high degree of accuracy and the necessary redundancy. The computers process and manage the navigational and attack data, provide automatic control of the peripheral systems and processing units, and signal malfunctions, if any, to the pilot and technical personnel, via the displays. The digital data buses and modular configuration impart to the avionics a high growth potential, such as will enable, in the future and at relatively low cost, the progressive updating of the plane. The AMX is equipped with UHF, VHF and IFF equipment for communications and identification. Its navigational aids include a Litton Italia inertial system, a radar altimeter, a TACAN (replaced in the Brazilian units by a VOR/ILS) and a SAHRS [Secondary Altitude and Heading Reference System]. The plane is also equipped with a Microtecnica ADC [Air Data Computer] and provision has been made for the installation of a GPS [Global Positioning System] and MLS [Microwave Landing System].

For the aiming and release of its armament, the AMX is equipped with a Litton computer linked to an FIAR Pointer ranging radar developed from the Israelis' Elta EL/M-2001B. The EL/2001 is a pulse-Doppler radar operating in the I/J band, and is used for measuring distances in air-to-air and air-to-ground missions. Because of its small size (overall length 49 cm, base diameter 45 cm) and light weight (less than 50 kg), the EL/2001B is easily installed aboard many modern fighter planes, even as a retrofit. For the AMX antiship version (the development of which was announced at the 1986 Farnborough Show), FIAR has proposed as an alternative to the Pointer, the new Grifar P2801 radar, which is optimized for use with the stand-off, fire-and-forget type of air-to-surface armament. An OMI-Selenia system is also available for the management of external loads. To enhance the plane's survival capability in a hostile environment, the AMX has been equipped with ECM equipment made by Electronica. In particular, pending the availability of suitable chaff dispenser and flares, the plane is equipped with an infrared and a radar warning receiver. The AMX's cockpit is equipped with a head-up display, a TV/IR, and a head-down map display. The OMI-Selenia HUD, together with the two systems just mentioned, provide the pilot with an extremely accurate aiming capability. The map display and the TV/IR provide the pilot with a synthetic presentation of the zone being overflown and of the tactical situation, thus ensuring accuracy of navigation and target approach.

FACTORY AUTOMATION, ROBOTICS

Italy, USSR, FRG Joint Venture To Produce Automated Systems

3698M086 Rome FINMECCANICA in Italian 31 Oct 88 pp 1-2

[Text] An agreement establishing a joint venture among Ansaldo, the FRG company Indramat—a member of the Mannesmann group—and the Soviet firm Tbilisi Elektroprivod was signed in Moscow by Gio Batta Clavariono, the president of Ansaldo, Dietes Diehl, the managing director of Indramat, and Gaioz Galvanadze, the managing director of Tbilisi Elektroprivod. This is the first trilateral joint venture ever undertaken by an Italian company in the Soviet Union.

The joint venture's starting capital will amount to some 6 billion lire, the majority of which (55 percent) will be held by the Soviets, while the remaining 45 percent will be split between the Italian and German partners.

The new company will set up a plant in Tbilisi, the capital city of Georgia, for the production of electrical motors and equipment for controlling machine tools and robots. The total investment required by the project, which is expected to be fully operational by 1995, is estimated to be approximately $ 350 million (more than 470 billion lire). In the first phase, from 1990 until 1995, the plant will produce 7,500 electrical actuators per year, resulting in total sales of approximately 50 billion lire. A large portion of the production of the newly established company, which will initially have 300 employees, will be marketed in the Soviet market (80 percent), while the remainder will be sent to the COMECON countries and to Western Europe.

After signing the agreement, Clavarino pointed out that this is an important step for Ansaldo, since it provides the company with a productive opportunity for penetrating the Soviet market. As Clavarino put it, "For all

intents and purposes we will become part-owners of the company, which is expected to become reasonably profitable in the near future."

FRG Firm Develops Carbon Dioxide Laser Cutting System

36980034b Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 22 Sep 88 p 8

[Article: "Higher Productivity for Carbon Dioxide Laser"]

[Text] Frankfurt—Messer Griesheim has developed the new Lascontour 2.0 portal beam positioning system with flying optics for two-dimensional material processing with stationary carbon dioxide lasers. It is intended to complement the existing equipment program for two- and three-dimensional beam positioning. Messer Griesheim specifies three features which will characterize the new system: First, the high processing speed of the light, movable mirror with up to 60 meters per minute, second, the large working area of the portal, which permits cutting on two 5-meter-large work pieces, and ,third, the incorporation of the system into a production line which will be possible through the portal which is open on the front sides.

Several variants of supporting tables are being offered for this system: a simple cutting grate, a cutting table with a pallet that can be run out and removed, and an alternating table with "continuous function." This arrangement, which is intended to save time, consists of two tables. While the laser is cutting building components on the rear table, the operator removes the parts from the front table and puts a new sheet on it. After cutting, the two tables change positions in the space of 30 seconds. The "travelling grate" system is said to represent a special solution for automated production. Thus, it is said to guarantee the highest throughput. During cutting, it serves as a material support; after cutting, it serves as a conveyor belt which carries off the construction parts and simultaneously positions a new sheet under the laser portal.

Equipped with a high frequency-pumped 1,000-Watt carbon dioxide laser, the flying optics cut, for example, unalloyed steel up to 10 millimeters thick and high-grade steel up to 8 millimeters thick with high cutting quality; the contour precision is said to be plus/minus 0.05 millimeters. Frequency-regulated three-phase motors for both longitudinal drives (gantry axes) of the x-axis and for the cross drive for the y-axis are said to conduct rapidly and precisely for the reflecting mirror. Today, computer-numeric control (CNC) is almost standard in machine tool building. It is up to ten times faster, compensates for contour variation, adapts the programmed laser output to the processing speed, and controls cutting gas pressure and laser parameters.

LASERS, SENSORS, OPTICS

FRG Research Ministry Funds Free Electron Laser Project

36980083a Frankfurt/Main FRANKFURTER ALLGEMEINE in German 2 Nov 88 p N1

[Article: "A 'Free-Electron Laser' for the FRG. Ready for Operation in Three Years. Project in Darmstadt"]

[Text] The first "free-electron laser" in the FRG will probably be built at the technical university in Darmstadt. The Ministry for Research and Technology has now appropriated DM 5 million for the project which will take place at the Darmstadt supe rconductive electron accelerator. With "free-electron lasers," intense monochromatic light is generated not in the usual way by the transfer of electrons within the atomic shell, but rather by electrons which are shot into a magnet in which the direction of the field changes every few centimeters. In Darmstadt, electron packages with peak currents of 3 amperes are also accelerated to an energy level of 30 to 50 million electron volts. Then the electron beam passes through a magnetic field which is generated by 80 permanent magnets of alternating polarity—the so-called undulator. Within this magnetic field, the electrons complete a "slalom run" and in so doing emit radiation in the form of infrared light with wave lengths of two to five micrometers. The wave length of the light depends on the distance of the magnet and the speed of the electrons. Mirrors at the ends of the undulator are used to increase the radiant energy, thus producing a laser beam with an output of 500 kilowatts. The time needed for the initial construction phase is expected to be approximately three years.

Adjustable sources of infrared light radiation are rare. Short pulses of infrared laser light of only a few picoseconds permit new kinds of spectroscopic investigations of solid objects and molecules. It is possible that powerful pulsed lasers can be used to remove human tissue by applying heat. "Free-electron lasers" are also expected to be developed at the Max Planck Institute for quantum optics in Garching, as well as at the Universities of Dortmund and Frankfurt. The x-ray lasers of the SDI program, extolled as wonder weapons but still far from being implemented (if even possible), have nothing in common with all these research instruments.

FRG: Battelle Frankfurt on Materials Processing with Carbon Dioxide Lasers

3698M025 Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 486, 29 Aug 88 p 7

[Text] As laser techniques in cutting, welding, surface treatment, and many other fields are easily automated, they can be used to great technical and economic benefit if their advantages and disadvantages are properly detected and assessed.

When this technology is introduced, several physical, material, and economic problems face industrial users of lasers in particular, but also the manufacturers of corresponding equipment. These issues are difficult to address because of a flood of specialist and patent literature as well as company brochures.

The Battelle Institute in Frankfurt is planning a group project, "Materials Processing With Carbon Dioxide Lasers, Technological Possibilities and Economic Opportunities." The objective of this project is to provide general guidelines for laser applications as well as technical and economic support for introducing this manufacturing technology.

The project proposal, with detailed information on the procedures and conditions for participation, is available free of charge to all interested parties. Contact: Dr Fehmi Nilmen; the Battelle Institute, Frankfurt; Am Roemerhof 35; 6000 Frankfurt 90; Tel. 069/7908-2604, Telex 411 966.

MICROELECTRONICS

FRG Firm Develops Plasma Etching System for Semiconductors

36980034a Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 22 Sep 88 p 8

[Article by lmz: "Plasma Etching System for Semiconductor Production"]

[Excerpts] Frankfurt—Among the manufacturing processes for making integrated circuits, reactive ion etching occupies a crucial place. It is the most important method for working out the structures transferred to the wafer by means of lithography and mask matching technique.

For this demanding field of semiconductor manufacturing technology the firm of Leybold-Heraeus, located in Hanau, has with great expenditure developed a new family of systems which it is marketing. The MPE 3000 multichamber plasma etching system is constructed in modular fashion. The wafers are transported singly under vacuum by a two-axle robot arm into each processing chamber and are worked on there. Thus, several different processing technologies can be combined in-line.

Also, during the practically particle-free transport, the highest level of clean-room condition is maintained. Together with a flawless processing technique, these are the preconditions for producing structural widths in the range of 0.5 to 0.8 micrometers consistently. The option of being able to process wafers up to 200 millimeters in diameter is intended to open up the market of the 1990's for the MPE system.

Fiar, CISE To Develop Photovoltaic GaAs Cells

3698M087 Milan CHIMICA OGGI in Italian Oct 88 p 76

[Text] CISE and Fiar will use gallium arsenide cells to develop the photovoltaic panels designed to power a small satellite which is scheduled to be launched in 1990 by the European carrier rocket Ariane.

Compared to the silicon cells used to date, GaAs solar cells offer more efficient solar energy conversion as well as higher resistance to temperature and radiation. CISE will manufacture about 1,000 cells for the project, each measuring 2x2 cm^2, and Fiar will provide the sheathing for the cells and the panels.

SCIENCE & TECHNOLOGY POLICY

EC Research Project Funding Criticized

36980088a Hamburg DIE ZEIT in German 4 Nov 88 p 46

[Article by Otto Ulrich, engineer and social scientist, staff member of the Office of the Federal Chancellor from 1975 through 1985: "More Chips or Olive Groves?"; first paragraph is DIE ZEIT introduction]

[Text] Europe must improve coordination of its many fragmented programs. Many Europeans consider Antonio Ruperti a messenger of hope. The diminutive professor has a vision and, as Italian Minister for Research and Universities, he also has a job which gives him the opportunity to open a new perspective for European research. He is convinced that the impetus generated by joint research in Europe must also be secured in the cultural arena through close cooperation of European universities.

Rolf Linkohr, energy, research, and technology spokesman for socialist groups in the European Parliament, seeks "real Utopias of this type," as he stressed at a meeting of representatives of the European Left in Edinburgh, Scotland. The concern there was the search for perspectives for research and technology in Europe—beyond today's conservative policy styles. "Beginning in 1993, the European internal market will also make a restructuring of European research necessary. And new foundations must be developed for that today." According to Linkohr the basic question is whether, in view of this internal market, all the switches on the track to the future of joint European research have been properly set, or whether we will be faced by totally new conditions.

But what exactly is that—European research—upon which many insist that Europe's future depends? It resembles a three-layered matreshka doll: The innermost core is the EC's multiyear framework program for 1987 through 1991 and also, clearly interconnected with it, EUREKA, the European research cooperation program. Between the inside and the outside is a profusion of international research facilities such as the European

Space Agency ESA in Paris and the European Organization for Nuclear Research CERN in Geneva. However, giving the doll its external appearance and overshadowing everything with their power are the national and bilateral research efforts of the community's individual member countries along with the recently expanding research commitment of European "Big Business" with its own cooperative international research.

This combined public and private research potential which the 12 EC member countries mustered for research and technology in the past year amounted—according to the estimate of the Batelle Research Institute—to 78 billion ECU; the figure for the United States was 100 billion ECU; for Japan, 69 billion ECU. (1 ECU = DM2.07). Insiders have long been aware that no European identity has yet emerged from the aggregate of national research egos. The recognition is there of how much ground remains to be covered in terms of policy to achieve what is always being touted, i.e., a common European research and technology policy "from a single mold"—in place of today's poorly coordinated dynamics.

Practical Cooperation

Because, compared to the challenging research budgets of the Americans and the Japanese, the amount that the national offices of research in the major European countries have appropriated for actual European research in recent years is shameful: For the new EC research framework program for 1987 through 1991, an average of 1.1 billion ECU is available per year. However, in 1982 it was only half that.

EUREKA's research budget currently includes some 4.5 billion ECU for 240 projects. In comparison: In 1987 European farmers received 27 billion ECU from the overall EC budget, i.e., some 75 percent, and last year the FRG government alone spent 6.9 billion ECU—spread over all departments—for research and technology, including 1.4 billion just for military research. Karl-Heinz Narjes, still commissioner of research in Brussels, describes the new research framework program as an "utter disgrace." There is, of course, the promise of the EC Council of Ministers, the EC Commission, and the European Parliament to double the funding for the EC research framework program from 1991 on from the current two percent to four percent of the overall EC budget. Yet the questions remain: What priorities will determine what is allocated and who should cooperate with whom?

Perhaps it is not merely money that is needed to replace the apathetic duplication in European research activities with cooperation. Opportunities for this might be found in intelligent initiatives to encourage mobility of technical personnel, scientists, and managers from industry, research institutes, and—in Minister Ruperti's opinion—European universities to promote the practice of European thinking "on the job" through practical cooperation on a personal level.

The EC Commission has been trying since 1974 with its "Coordination of Single Country Policies in the Science and Technology Area" to prevent reverting in the future to one Europe of chips and another Europe of olive groves. Their response is the EC Multiyear Research Framework Program, a community instrument with which to achieve the objective of the "European Technological Community." The purpose of this overall concept is to assess individual national research projects on the basis of their "European-ness" and to support them according to uniform criteria. Duplicate research should thus be avoided. Guaranteeing this is a political tour de force which must be performed by the Commission and the Council of Ministers with the drafting and development of large EC research projects.

The new EC multiyear research program has been in effect since September 1987 and provides that until 1991 the major part of EC research funding will flow to so-called "strategic" areas such as information technology and communications, energy, and modernization of industrial structures. The largest program area by far is focused on creating a single large European market in the area of information technology (ESPRIT II [European Strategic Program for R&D in Information Technologies]) and telecommunications (RACE [R&D in Advanced Communications Technologies for Europe]).

ESPRIT began in 1984 with a first phase (1984 through 1988). It was provided with 750 million ECU of EC funds. ESPRIT II has 1.6 billion ECU at its disposal through 1992. The strategic objective of this package is the support of international industrial cooperation within the EC in the area of precompetitive R&D in the sectors of microelectronics and peripherals, information processing systems, and applications technologies. It also encompasses the creation of Europe-wide standards as well as a greater European influence in the establishment of worldwide standards. So far 227 ESPRIT projects have begun—half of them with German participation.

RACE concerns R&D in telecommunications for Europe. Totally new telecommunications services are to be introduced in Europe beginning in 1995. For this, 550 million ECU are available.

In energy research—the second largest program area—nuclear fusion research is gradually becoming a bottomless pit. This program combines all research directed toward a future fusion reactor. The Joint European Torus (JET) in Culham, England, is the large-scale joint experiment in fusion research.

European nuclear research still will receive 540 million ECU from the framework program through 1991; on the other hand, research in non-nuclear forms of energy and rational use of energy will not receive even half that amount.

The "Basic Research in Industrial Technologies for Europe" program (BRITE) targets technological developments in the areas of industrial production technologies and use of advanced materials. It promotes research in small and middle-sized firms. It concerns improvement of reliability of processes and products, laser technology, computer-aided design (CAD), and computer-integrated manufacturing (CIM). Through 1992, approximately DM24 million could flow to German industry and research institutes from this program.

Interesting Think-Tank

A number of smaller, interesting programs rounds out the framework program, for example:—SCIENCE: A layout of approximately 175 million ECU through 1991 is to support cooperation of research facilities and universities.—DRIVE: New systems of road traffic informatics are supported by more than 60 million ECU. With this, the Commission would like to achieve a breakthrough in road safety and an improvement in the environmental impact of road traffic.—DELTA: Over a 2-year period, more than 20 million ECU are to be used to investigate and optimize the infrastructure for use of information technology and telecommunications for Community-wide systems of noise technology and instruction by computer.

Although this new EC research framework program is impressively focused, it reveals a—no longer correctable—flaw. Too little was learned from experience during the first research framework program of 1984 through 1987. There has been no evaluation of European research activity to date. All these programs which are considered so attractive have a defect: There is no goal-based evaluation of the consequences of technology. It is true that with FAST the EC has an interesting think-tank which is supposed to forecast scientific and technical development and evaluate its political structural foundations, but its work is not meshed with the development of programs. It remains problematic and unclear how the purported objective, the European Technological Community, can be achieved without the proper accompaniments to research and without evaluation of the social impact of technology.

In addition to this inherent weakness in the new EC research framework program, there is a strained relationship with EUREKA, that darling of the major European countries, which was created on French initiative in June 1985 and is supposed to unite scientists from industry and research institutes from various EC countries. EUREKA developed out of the criticism of the long-standing practice of European research policy which, in the opinion of Paris and Bonn, is much too narrow-minded and bureaucratic. Therefore, EUREKA was designed outside the reach of political decisions. The European Parliament was never involved in this initiative. That, however, has not prevented it from becoming more technocratic. Because 17 European countries—Austria, Finland, Iceland, Norway, and Sweden, in addition to the 12 EC member countries—and the EC Commission are involved.

The driving force for this European initiative was the fear that the threatening technological thrust of the American SDI program would leave European industry trailing dramatically. From this uncertainty was born a new concept of company activity: a technology-based strategic partnership which Jochen Richert of the board of directors of the German Federation of Labor Unions promptly characterized thus, "Now, instead of society-based control and design of technological progress, the dominance of technology would be established as a universal remedy."

The Theory Has Failed

The main emphases of EUREKA's 240 current cooperative projects fall—as in the EC research framework program—in the area of information and communications technology, production, and biotechnology. Thus, duplicate research occurs because—at least to date—the theory has failed. The plan was that the European research framework would operate in the precompetitive arena and that EUREKA would carry out research closer to the demands of the market. So far, according to a report from European bankers, 89 percent of the EUREKA projects would fit under the umbrella of the EC research framework program as well.

The search for new starting points for the organization of a European research system seems far from finished. In trade policy, agriculture, competition law, and customs regulations, the transfer of decisionmaking from national governments and parliaments to Brussels is in full swing. And no one can any longer dodge the crucial European question of what political consequences will result from the movement toward one Europe, accelerated thanks to Helmut Kohl, for a shifting of national research competences to Brussels. Fluctuating between fears of loss of sovereignty and lofty European thoughts, there are no discernible indications in the member countries of how the future of joint European research can be prepared for politically at this time. Our federal government can continue to dedicate itself to the creative phase of reflection in the certainty that in Parliament hardly anyone is interested in European activities in the area of research and technology. Federal Minister for Research and Technology Heinz Riesenhuber behaves in Brussels pretty much without any democratic control from the German Bundestag. A parliamentary relocation of the responsibility for the Bonn water works to the European Parliament in Strasbourg would scarcely be noticed. Because so far Bonn has been giving its parliamentary blessing to the EC research framework program long after issues have been decided in the EC Council of Ministers. No one has ever gotten excited about this. But if Jacques Delors makes a another move and takes the national governments at their word with the "Single Europe Act," things will become serious for

the carefully tended FRG research garden, especially since—so it seems—no conceptual provisions have been made there either.

The necessary losses of autonomy will be painful, but no one really seriously believes that the great objective, the "European Technological Community"—the locomotive, so to speak, which is going to secure Europe's place as the leader of the world market—is even achievable if we continue to hole up in our "mighty fortress," cling to our possessions, and again surrender Europe to the slipshod ways of callous EC officials in the national capitals.

Aerospace Industry Coordinator Riedl Reports on FRG Policies

36980084a Stuttgart FLUG REVUE in German Nov 88 pp 36-37

[Article by Klaus Mueller: Industrial Policy: Bonn's Attitude Toward the Aerospace Industry. Securing the Future of the FRG]

[Text] Continue to give increasing support to those projects which will assure the future of the FRG as an industrial nation—that is the recommendation of what has been called the Riedl report. It summarizes the opinions of the four participating ministries, and goes to the cabinet on 2 November.

The report has been in preparation for at least a year, and even the draft was not circulated publicly for weeks after it was completed. At the same time the paper, dealing with the current state of the West German aerospace industry and written by Erich Riedl, parliamentary state secretary in the Federal Ministry for Economics and coordinator for aerospace, cannot be considered the source of much political controversy if the role of the FRG as an industrial nation is generally accepted. As a country with a "high level of salaries and small raw materials base," the FRG is dependent upon "international competitiveness in high-technology markets." A Weaker Base than that of the Competition

In its 26 pages (plus appendix), the draft of the Riedl report deals with the difficulties with which German industry must contend. The exclusionary type of competition in the civilian aircraft industry, stagnation in the area of military contracts, the exchange rate of the dollar and the massive support received by the competition via the military and research budgets in the US, France and Japan, for example, strengthens their position. In addition, German companies do not have the same degree of access to the capital market as their British and American competitors, for example. The manufacture of larger aircraft models, thereby increasing profitability, is made more difficult by the relatively small domestic market.

In addition to the synergistic effect on other industries, the productivity of the aerospace industry has also brought it to the forefront of the German economy: its gross product increased from 100 to 185 index points from 1970 to 1985, which corresponds to an average annual growth rate of four percent. The production sector as a whole reached a value of only 158 points during the same period, with an annual increase of 3.1 percent.

The report, to which the Ministries for Defense, Transport, and Research and Technology—in addition to the Ministry for Economics—have added their conceptions of the current state of affairs, concludes that at the present time German industry must complete several overlapping adaptation processes: It must concentrate to a greater extent than heretofore on "profitable activities in the civilian sector," it must strengthen its technological position, it must improve its standing with regard to European and international cooperative effort, and—above all—it must improve its corporate efficiency.

As has been clearly evident for a number of years, the shift from military markets, which still account for roughly half of all sales, to civilian ones must be accelerated. The report indicates that even today there is excess production capacity in the military sector which must be compensated for through civilian programs and, to a lesser degree, through the space industry. Nevertheless, the number of employees involved in cell and engine manufacture dropped from 52,000 to 46,000 between 1980 and 1987; in the same period the percentage of those employed in military programs dropped from 63 to 48 percent. Apparently, the FRG government is giving no consideration to loosening the restrictions imposed on German industry with regard to the export of military equipment. Therefore, German industry is largely excluded from the opportunity available to the competition in the United States, Great Britain and France, for example, to invest profits acquired through sales of larger production runs as a cushion for the financing of its own civilian programs.

The goal of future federal funding must be for German industry to catch up to its European partners in those more challenging technologies in which it still lags behind in some cases. Such technologies include engine and equipment technologies . In referring to the acquisition of Embraer Brasilia by DLT, the report warns of the increasing competitiveness of the emerging nations in the field of aviation as well.

Technology as Target of Future Federal Funding

The majority of civilian, military and space programs are pursued within a framework of international cooperation. In order to maintain the systems development capability of German industry, the report recommends that the Dornier 328 and—in the interest of medium-scale industries—the Seastar be the targets of federal funding. The Crisp design concept—preliminary work toward development of a prop-jet? [Propfan] engine—should also continue to be funded by the government, as should work on new materials in the fields of sensory analysis and automated error and damage diagnosis. With regard to the space industry, the report sees as

future areas of national emphasis the use of zero gravity, the engineering of automated systems, robotics, and supersonic technology as used in the Saenger reusable space transport vehicle.

Not to be overlooked is also, naturally, the demand made by politicians that industry be willing to take on a greater risk than heretofore. Without naming names, the report calls for "the largest German aircraft manufacturer" to reorder its corporate structure so that it is more in tune with "industrial leadership and greater corporate responsibility." The report also calls for reducing the "excess capacity at the two largest German systems development firms," and goes on to say that the reduced ability to compete in the military and space sectors, a feared consequence of a reordering of the German industrial structure, must be offset by opening up the projects to competitive bidding, even beyond Germany's borders. Construction of Civilian Helicopters Questionable

The report sees the continued single-handed effort in the construction of helicopters for civilian use in the FRG as problematical in view of worldwide excess capacity. In this regard, the development of a program of international cooperation is recommended, which would cover the production of a combat helicopter in cooperation with the French. The report also promises political support for efforts to achieve a cooperative venture between Airbus Industrie and American manufacturers. Such a venture could take the wind out of the sails of those in the United States who have attacked the Europeans for allegedly contravening the GATT Regulations. Opening up to Asian markets, such as is already being practiced by the MBB Company with its contacts in the People's Republic of China, India and Indonesia, is also recommended. In Japan and the People's Republic of China, American manufacturers have already been able to achieve "a cooperative advantage," the report concludes.

Not all desirable projects can be funded by the government in view of the tense budget situation and the targeted reduction of subsidies. The FRG government should therefore establish priorities, for example in the Airbus program, at the development stage, while at the same time reducing funding rates step by step. The Dornier 328 will be included among those projects to receive federal funds as soon as the project proves itself to be economically sound. In general, however, further projects "should be investigated to determine whether they will strengthen the position of German industry with regard to aircraft engines" before a decision on funding is reached.

There is extensive criticism of the management of the European Airbus program, in which German industry has a 38.5 percent share. The report agrees with the decision to tighten control of the organization which will bring the previously divided cost responsibility—which has to date rested with the individual partners—in line with the realistic market prices of the parent organization Airbus Industrie. In the future, those responsible for manufacture from the four partner companies will be delegated to the executive board of Airbus Industrie, and a financial executive board will be charged with clarifying costs. The desired establishment of a stock company in accordance with European law, however, will not be possible until 1992 within the framework of the domestic European market.

Because it summarizes the views of the four departmental ministers responsible for it, the report and its recommendations are likely to encounter objections in the Cabinet only for budgetary reasons. The extent to which industry is in agreement with the considerations and conclusions presented in the report will remain to be seen after the cabinet discussion which is scheduled for November 2.

Italy: Snia BPD 1988-90 Programs Outlined

3698M061 Rome HI-TECH in Italian 1 Sep 88 p 11

[Text] Snia BPD's 1988-90 development program emphasizes research activities in highly innovative areas such as functional chemistry, biotechnology, and composite materials without overlooking traditional areas of research. Research will primarily be focused on the finalization and industrialization of new products developed with proprietary know-how, but will be integrated with contributions by external centers such as specialized laboratories and/or small, technologically advanced production units.

However, research will be tailored to the areas of development already scheduled:

— In the defense and aerospace sectors, research will focus on launch powders, solid and liquid propellants, and development of the Firos, Medusa, and Naros systems, in addition to work on the Sidewinder missile. Rocket missile systems and sensor engineering for weapons systems will be developed later in cooperation with third parties. Research activities relative to the SDI and advanced ammunition will also be advanced.

— In the area of chemical fibers, major impetus will be given to the development of technical functional fibers, particularly semipermeable materials (made of both fiber and membrane) and soundproofing materials, as well as to the development of structural fibers (silicon carbide whiskers and high-modulus polyethylene threads) with high mechanical characteristics. Efforts will continue to finalize new kinds of polyester threads and improved fire-resistant acrylic flakes, along with efforts to develop continuous ironing and spinning processes and new combinations of blended artificial fibers.

— In the chemical sector, research activities of the new Technology Center for Molding Systems and the new Brescia-based biotechnology consortium will be expanded. Research efforts will focus on finalizing

industrial processes for fine chemistry intermediates (benzylcyanide and benzophenone), new chlorination technology, sulfides, and organic compound nitration. Needless to say, research will also aim at improving the caprolactam process as well as developing polymer alloys, extremely shock-resistant blends, new reinforced and improved materials, flame-proof materials, and highly adhesive and biodegradable films.

— In the field of bioengineering, research will focus on developing enzymatic immunodiagnostic systems, special cardiac valves, and a new type of pacemaker. Increasing importance will be attached to participation in the Icaros program. This will call for considerable effort in acquiring know-how as well as for greater specialization on the part of numerous research centers.

Scheduled investments total 200 billion lire over 3 years.

Triennial Investments of the Snia Group

Sector	Know-how and Research (projected)	Development and Innovation	Consolidation	Environment, Ecology, Safety	Total
Space and Defense	65	102	32	33	232
Chemical fibers	63	78	55	29	225
Chemistry	60	65	48	42	215
Bioengineering	12	16	8	6	42
Textiles		10	13	4	27
Other activities			6		6
Group total	200	271	162	114	747

The Group's Research Centers

Snia Bpd	Military and space products	Colleferro (RM)
Snia Fibre	Synthetic textiles and technical fibers	Cesano M. (MI)
Novaceta	Artificial textile fibers	Magenta (MI)
Snia Tecnopolimeri	Technopolyers and new matrices	Ceriano L. (MI)
Caffaro	Chlorine chemistry	Brescia
Chemica del Fruili	Fine chemistry	Torviscosa (UD)
Molding Systems	Composite materials	Castellaccio (RM)
Sorin	Bioengineering	Saluggia (VC)
Crc	Biotechnology	S. Giovanni al Natisone (UD)

TECHNOLOGY TRANSFER

FRG Reports Increased Technology Transfer to East Bloc

36980089b Frankfurt/Main FRANKFURTER RUNDSCHAU in German 22 Nov 88 p 7

[Article: "East Bloc Technology Theft Functions Smoothly"; first paragraph is FRANKFURTER RUNDSCHAU introduction]

[Text] Berlin—It is by no means necessary to track down Agent X by night with a leather coat and slouch-hat to give him the new service-free super battery best suited for use in frozen Siberia. Nor does the secret agent meet "with his chief behind the cross in the cemetery", according to the former president of the Federal Information Service, Heribert Hellenbroich. Today's industrial spy, an engineer in the R&D department, more likely has the quite specific assignment of obtaining copies of the documents with company-internal file numbers 7/86 and 8/86. "They don't want things, they want information," says Hellenbroich about the systematic efforts of the East Bloc countries to plug into the standards of Western industry using illegal technology transfer.

When design problems arise which cannot be solved by their own means, firms in the GDR and the USSR turn to central coordinating offices which keep regular order books. The attempt is then made to close the gaps in know-how, especially via information services, but also via such "harmless" institutions as the Academy of the Sciences or the Ministry of Foreign Affairs. Hellenbroich reported this in Berlin at a conference of security and personnel managers from high-tech companies.

Everything of special interest for technical and scientific investigation in the West is entered, for example, in a so-called "red book" with at least 27 chapters in Moscow. And, from the GDR, it is known that in 1985 the head of the State Security Police, Erich Mielke, in a

speech to people of his agency spoke of the necessity of assuring "the growth of national economic performance." Obviously, according to Hellenbroich, they took this appeal to heart. At any rate, for the first time in 1986 and again this year, industrial and scientific espionage ranked second right behind political espionage in the report of the Office for the Protection of the Constitution of the FRG government. Small and middle-sized high-tech companies are especially hard hit by organized theft of technology (referred to in the conference program as "Klau-how"). According to Hellenbroich, the opinion of many Western companies that countries in which the state handles foreign trade will not be able to capitalize on their espionage knowledge until the next generation of computers is built is completely wrong. "Utilization takes place quickly, specifically, and thoroughly." The system is so well organized that the state enterprises (VEB's) even have to pay for espionage orders filled.

Annual damage to the FRG's national economy from economic and scientific espionage is estimated at almost DM8 billion. And the opinion expressed from all quarters during the conference was that the trend is likely to increase with perestroika and glasnost due to increasing contacts between East and West.

Money plays a relatively minor role in the recruiting efforts of Eastern intelligence services. Rather, the feeling of technical personnel that they get too little recognition on the job is systematically exploited. Eastern "assault troops" are trained to give this recognition, noted Hellenbroich, "and it is astounding how well this works." The bait may be the bear-hunting trip to Hungary, authorization to export valuable icons, exemption from minimum exchange limits, or permission for the woman that one has met and fallen in love with in the East Bloc to emigrate to be married. Another favorite method of Eastern recruiters is reportedly to provoke currency violations or even traffic offenses (supplying alcohol to drivers) to gain leverage. On the other hand, spies trained as technical personnel and intelligence agents are reportedly smuggled out of the GDR. For example, they are "hidden among the many legal immigrants" or fake escapes are arranged for them. FRG companies are especially happy to employ former GDR citizens; because of their knowledge and willingness to work hard they are not infrequently preferred over domestic university graduates.

In the interest of their own defense, companies must foster a climate in which employees who find themselves in conflict "are able to discuss unpleasant things without fear of being fired." According to Hellenbroich, whereas police officers, other government employees, or soldiers relatively frequently confide in their superiors, "in industry the disclosure rate tends toward zero." The ex-head of the Office for the Protection of the Constitution feels that even far simpler security precautions than a pleasant work atmosphere are appropriate for deterring industrial spies. "Why isn't the number of photocopies recorded—and, for that matter, why is the copier installed off in the corner?"

COMPUTERS

GDR's Research Center Examining Integratable Software

23020004 East Berlin
RECHENTECHNIK-DATENVERARBEITUNG in German No 9, 1988 pp 5-6

[Article by Dr. Peter Wiese, Dr. Dietmar Gollnick, Lutz Pape, VEB Center for Applications Research Software Operation CAD/CAM: "Integratable Software"]

[Text] The development, production, and multiple use of software is crucial for the accelerated development and introduction of key technologies such as microelectronics, CAD/CAM technology, and information and communications technology.

The use of workstation-oriented computer technology results in new quality and quantity requirements regarding the provision of software. The use of high-quality computer solutions in increasingly numerous areas of the national economy is continuously opening new areas of application for computer technology which need to be supported by software. Therefore, the software to be used must be increasingly "integratable".

Integratable software means:
1. The software can be run on different levels of hardware (e.g., 16-bit or 32-bit computer technology) while maintaining almost identical functions.
2. Combining software products for various functions within one application solution.
3. Taking into account the user environment when specifying the goals of software development including effective ways of software provision and the transfer of knowledge.

One aspect which previously has not received enough attention in the GDR is that today the sale of software to the plants and institutions of the GDR economy requires complex capabilities. They consist of consultation, software sale, training, applications support, and software enhancements. This is all the more important since sectors of the economy which need to utilize computer technology today have little experience in this field and therefore need to rely primarily on the support provided by professional software developers. It is increasingly recognized that software is a commodity and therefore has a price.

In the socialist society, software production is part of the reproduction process of the national economy and constitutes the production of goods. Any process of software production constitutes a work and value creating process; the software as a product has utility value.

As a software CAD/CAM operation, the VEB LfA ensures its completely expanded reproduction by selling scientific and technical services and software including consultation, training, and application support. These services are important for national enterprises and institutions which lack people with special knowledge and experience in computer technology. The user is still responsible for streamlining the process by using modern computer technology. He is responsible for increasing the efficency of the production process by using modern computer technology, in particular CAD/CAM technology, and avoiding creating partial solutions. This frequently also requires scientific and technical services by the user.

To support user decision-making, it is particularly important to demonstrate software and hardware solutions in the form of reference solutions. These reference solutions are equally important for software development concerns since they will be able to specify further developmental goals based on a concrete configuration and in combination with many components. The VEB LfA software operation CAD/CAM has set itself the goal to develop such reference solutions for these areas:

CAD/CAM, Local Communications, and Integrated Systems.

Ensuring that the software the users invest in is widely applicable requires the provision of integratable solutions.

The software to be made available must be able to run on computer technology which is widely available in the GDR. The specialization of the hardware modules must allow for adaptation to a great variety of configurations. The VEB LfA software will continue to run primarily on the computers of the VEB combine Robotron PC 1715, A 7150, and EC 1834 or their enhancements (RVS K 1840) and on ESER-EDVA. The graphics adapter and communications card provided by the hardware manufacturer and other graphic peripherals will be supported.

Following international trends, a high degree of integration also requires development services in the area of firmware and the provision of combined hardware/software products. For this purpose, the VEB LfA has started developments together with cooperating partners.

Integratable solutions also include compatibility of software packages with each other. This is based on the assumption that both compatibility between products for different purposes (CAD/CAM, data management, communication, software development) and between products for various operation environments (hardware/operating system) must be ensured. This provides the possibility of creating comprehensive solutions for the software user supported by the software producer and using the modular system provided.

The VEB LfA will concentrate its efforts on making available multivalently usable software and provide users with applications support for specific situation to the extent possible. This enables the software operation to include the experience of application solutions both

into the development of integratable software and to pass it on to other users in the form of consultations.

Integratable solutions require upward compatibility. The software producer guarantees that there is no break in integratability when individual components are developed further into new versions. Therefore, interfaces between the products will be set and cover several versions and transformation products will be developed if transitions are necessary.

CAD Packages

As a central software operation, the VEB LfA has the task of providing primarily software for mechanical construction, for the design of printed circuit boards and on a larger scale, for the basis of production control.

For the tasks of mechanical construction the products PRO-CAD (for 16-bit PCs and 32-bit computers) are made available for various user needs together with the VEB Robotron bookkeeping machine plant Karl-Marx-Stadt PCCAC and MULTICAD (each for 16-bit PCs). The work done to develop software for the product data exchange, the provision of standardized NC-interfaces, calculations, and on-line communication possiblities with and without special hardware will lead to an integrated product line.

Software Covering Several Computer Architectures

With PRO-CAD, a powerful package is available in the CAD area both for 16-bit PCs and for 32-bit computers.

CCS 3 and CCSMV allow communication between all widely available computer classes and operating systems.

The software package PSU allows software developers working under the ESER operating systems OS/ES or SVM the use of a MUTOS compatible shell and thus all UNIX-tools.

The relational database operating system TOPAS is currently available for ESER-EDVA, SKR computers under MOS 1600 and on 32-bit computers.

Software Based on Computer Architecture

To make full use of the particular advantages of the modern 32-bit computer architecture the VEB LfA provides integratable software designed for this computer class.

In addition to the CAD products mentioned, the following products are of great importance to the user:

— For software development, tools such as a convenient mask generator, a language-sensitive editor, and other components supporting the software development process are provided.
— Data management is supported by the polling system DATAMANAGE and a central data dictionary.
— UniNet allows integration of 16-bit PCs into a network of 32-bit computers or use of the 32-bit computer as a server for file, printer, and communication.
— With INSYS, the VEB LfA offers an integrated package for 16-bit PCs which meets stringent requirements with regard to wordprocessing, graphics, calculation, and communication. It can be networked and also works with 32-bit computers. On this basis, software is generated for industry-oriented workstations, e.g., the package MAPLA for material planners.

Integration Packages and Software Application

Based on many years of experience in working together with users of VEB LfA software, a clear contradiction in the user approach to a problem solution can be seen. The majority of users already has relatively clear ideas as to which computer resources (hardware or software) should be used for the problem solution. When it comes to specific questions regarding the application problem, knowledge about the solutions the computer has to provide, the related organizational problems and the goals and effects are less clearly defined. The question what should be used to achieve something takes precedence over what should be done. This contradiction leads to a situation where users are frequently stubbornly oriented towards the use of specific software. This results in a fruitless argument over the suitable software product which does not help the actual issue, i.e. finding a manageable effective application program. The application aspect should have precedence over the systems aspect. This fact formed the basis for placing the cooperation with users on a higher level. For this purpose and following international tendency in the provision of software, VEB LfA has set the following goals:

1. Purchase of a software products is combined with a consultation regarding application conditions and possibilities. For individual products, a limited test contract could be entered into.
2. For new developments or new versions of software products, test partners in industry are sought who would receive these software products against a small charge. This requires close cooperaation with the development collective to be able to incorporate the findings from on-site use into advanced development and perfection.
3. Software products by the VEB LfA are adapted to changed hardware and software conditions. The developer collective will guarantee support for the software life cycle.

As the VEB LfA developed into a software operation, it became increasingly clear that successful, high-quality software products can only be developed in close cooperation with users. The feed-back from user experience, continued development and perfection of the software products is indispensable.

Therefore, attempts are made at new forms of cooperation with users which better meet this requirement. At present, we practice the following forms of cooperation with users:

Software Forums

The developer collectives and the users inform each other on new development projects, user experience, malfunctions, problems and limits of software products. The users can get ready for new versions ahead of time and prepare for their application.

Product Demonstrations

The software operation presents software products and demonstrates them in actual use. Such events are used particularly to provide information on new software products.

Workshops

Technical papers on specific problems of software application are presented and followed by a discussion. This form of cooperation is inteded to use the discussion of problems and versions for qualifying software production.

Interest Groups/User Groups

Interest groups are formed for special areas of application. Cooperation is organized on the basis of contracts. Members commit to mutual information on new developments and experience with applications within the interest group, and strive towards compatibility of their software. Developed software is offered within the interest group/user group. For instance, on the initiative of the VEB LfA the interest groups CAD/CAM software for the area of mechanics/design were established, in which almost all users of the CAD software package PROCAD are represented, as well as a user group for users of UNIX-compatible operating systems.

Increased public relations work and concentration on user requirements naturally reqire more of the developer collectives. However, they are also a means of stimulating the collectives, since proximity to the user fosters good working relationships.

The VEB LfA will report on its line of software, its experience in the area of software development and on the development of reference solutions in the computer center. The current issue of RECHENTECHNIK/DATENVERARBEITUNG contains papers on data communicatioon and ongoing software development. Plans for the next issues of RD include information and experience in applications in the areas of CAD/CAM, data management, and information systems and software for the K 1840. The development collectives of the VEB LfA are very interested in a lively discussion with the readers.

'GDR's uniNet in Data Communications Infrastructure Described

23020005 East Berlin
RECHENTECHNIK-DATENVERARBEITUNG
in German No 9, 1988 pp 10-12

[Article by Roland Heckert, Joerg Peitz, VEB Center for Applications Research, Software Operation CAD/CAM: "In-house Communication in the Computer Center with uniNet"]

[Text] In consideration of its function as a reference center and to support in-house software development the VEB Center for Applications Research (LfA) is pursuing the goal of gradually establishing a convenient data communications infrastructure.

The current first phase is characterized by the following conditions:
- — increasingly heterogenous computer classes and types;
- — heterogenous, compatible LAN-solutions are not yet widely available;
- — convenient communications software covering several computer categories is still in its development phase.

Internationally, the short-distance connection of homogenous and inhomogenous computers is increasingly implemented by LAN solutions. At present, the GDR is also developing such heterogenous LAN solutions /1/, however, they are not yet widely available. Nationally and internationally, considerable efforts are being made towards specification, development, and introduction of standardized communications protocols, interfaces and services based on the OSI reference model, however, they have not yet resulted in generally usable products.

In the present phase, in-house communication requires the establishment of partial communications networks compatible with the hardware interfaces and communications solutions available on the different computers and adaptation of the communications software either by—extending a favored solution to all computers and operating systems, or—implementing gateways between different solutions.

The partial networks must be standardized gradually as standardized, heterogenous hardware and software components become available.

The partial networks which are available in the VEB LfA or are in the implementation phase are described below.

In-house Network Structure

Under the conditions mentioned above the establishment of star-shaped networks with the central 32-bit computers ESER-EDVA and K 1840 as nodes seems to be a reasonable basic structure (Fig. 1).

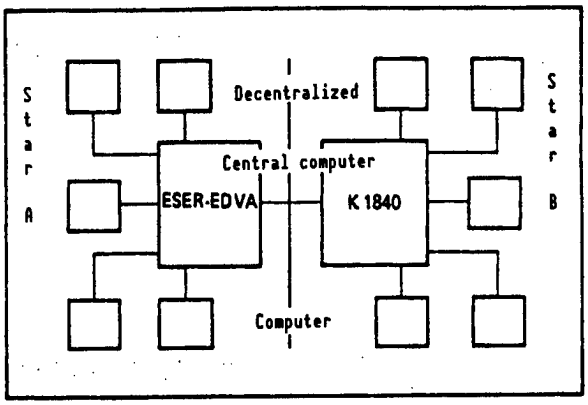

Figure 1. Summary of Network Topology

— Primary user requirements are interactive access to central processing and memory resources from their workstation-oriented computer technology.

— The host computers have sufficiently powerful networks for their homogenous interconnection. Therefore, a user connected to a host computer has at the same time network-wide access with switching provided by the connected host computer.

— Host computers are suitable as switching nodes between these connected decentralized computers.

— With access to the databases of the host computer relatively simple communications system can be developed, unless they are already part of the host computer network software.

— If frequently changing connections between subscribers to the computer network must be implemented and the number of subscribers is correspondingly high, the problem of interconnecting the communication lines can at present only be solved by a star-pattern network.

Personal computers can be connected to the host computer by terminal emulators and file transfer programms such as CCSMV /3/ or MOVESTAR /4/.

uniNET/DCP is superior to such programs by integrating the PCs into the network architecture of the 32-bit computers. In an in-house network with a topology as shown in Fig. 1, the connection between the two host computer types is very important since users working in parallel must be able to use this connection permanently.

Integration of 16-bit PCs into the SKRNET-Network with uniNET/DCP

With the introduction of the new 32-bit computer generation RVS K 1840 of the VEB combine Robotron the high-performance homogenous computer network SKRNET is also made available /5/. With uniNET/DCP (universal Network enhanced tools) a powerful software is available for the 16-bit computer with the operating system DCP and can be integrated into such a network. This software gives the user the means for accessing resources available in the network while maintaining the possibility of locally collecting, processing, and administering information.

Software As described in /6/, uniNet/DCP offers the following network services:

— network administration
— access to files at remote nodes
— file transfer
— shared use of resources
— electronic mail (MAIL)
— terminal emulation

The uniNet/DCP scheduler (SCH) monitors and controls the events. The uniNet/DCP-Network Process (DNP) supplies all network services including the processing of requests for network operations and background and network tasks to be performed. The Control Program (NCP) offers the user help for network control. The network control program NCP implements the following administrative network functions:

— Identifying the personal computer as terminal node for the 32-bit computer network
— Establishment of network node names, node addresses, access control information for other network nodes
— Changing of parameters which control the network services
— network monitor functions (including error logging)
— HELP function for all NCP commands, subcommands, and parameters.

The utilization of available memory resources is shared by usiing the virtual device support NDU. Each user can simultaneously open up to four virtual hard disk at different remote nodes and work with them the sames way as with local drives. In addition, NDU allows use of a virtual printer at a remote node. NDU provides the following functions:

— assigning logic drive names for existing or new binary files to remote nodes which can be used like DP hard disks
— accessing, closing, and erasing opened virtual hard disks
— assigning the logic uniform printer name NPRN to an existing or a new file at a remote node which is to function as a virtual printer
— indicating status information of all assigned virtual devices
— HELP functions for all NDU commands, subcommands, and parameters.

The uniNET/DCP components NFT (Network File Transfer allows access to files of the local and remote network node. The following basic functions are available:

—APPEND
—Updating files distributed in the network
—COPY
—Copying local or remote files
—DELETE
—deleting local or remote files
—DIRECTORY
—listing local or remote directories
—HELP
—provides information on NFT-commands and their parameters
—PRINT
—printing a remote file at the respective remote node
—SUBMIT
—transfer a command procedure to a remote node for processing
—TYPE
—displaying on screen the content of a remote or local file

SETHOST connects the personal computer at the local node with a remote 32-bit computer (host node) and makes it possible to work with the PC the same way as with a terminal which is connected to this 32-bit computer.

SETHOST is able to establish and manage several connections. The message transfer program MAIL allows the transmission of messages and text files to other network nodes.

Messages can be sent to pre-defined user groups using distributer lists.

A uniNet/DCP node cannot receive messages from other nodes via MAIL directly. However, users at remote nodes can answer the local node messages or send their own messages to an alternate address. The alternate address can be indicated automatically via MAIL.

The uniNet/DCP program can be run on the EC 1834 with the DCP 3.20 operating system, on the A 7150 with the operating system DCP 1700 3.20 and on compatible systems.

Personal computers are integrated into the network as end nodes. From such an end node all network nodes can be reached by using the switching function of other network computers (switching nodes). The uniNet/DCP environment comprises the complete network of the 32-bit computers as well as the PCs connected to it (Fig. 2)

A terminal line of the K 1840 is defined as a network line either temporarily or permanently. For transmitting via the V.24 interface the transmission procedure DDCMP (asynchronous) is used. The baud rate can be selected

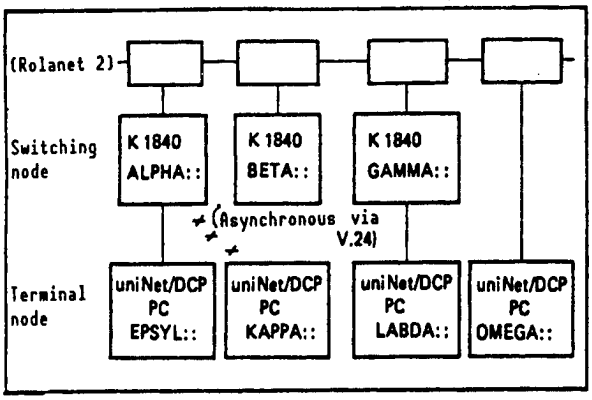

Figure 2. Sample Architecture of a 32-Bit SKRNET Network into which 16-Bit Computers are Integrated Using uniNET/DCP

between 1200 and 9600 bits/s; a half duplex modem control is not supported. When Rolanet2-computers are available for 16-bit PCs and the K 1840, the network can also be connected by integration into a LAN.

Application of uniNet/DCP in the LfA In-House Network

Those in charge of the RVS sytem established a virtual hard disk in a system directory on which DCP software which is used centrally and generally is stored. This virtual hard disk can be used by all uniNet users as a virtual drive in the read-only access mode. To facilitate work the disk is subdivided into subdirectories by subject matters. System programming which constantly updates and completes the disk content has write access. This avoids the existence of identical DCP software on floppy disks or hard disks of several users and ensures central data security for a large part of the PC software.

Integrating ESER-EDVA into the In-House Network

At present, a 32-bit computer and an ESER-EDVA are connected in the VEB LfA under SVM via a V.24 asynchronous line with 9600 bits/s. CCSMV/SVM and CCSMV/32 are used as communications software /3/.

They are used in two modes:

—public use

On the 32-bit computer side, CCSMV/32 operates as a server in a specifically established process. Procedures for implementing a file transfer from and to the 32-bit computer are available to PTS users via CCSMV. The conversion from the current directory of the CCSMV server process on the 32-bit computer side into a user directory with read and write access for the general public is also supported.

—Use by the people responsible for SVM management.

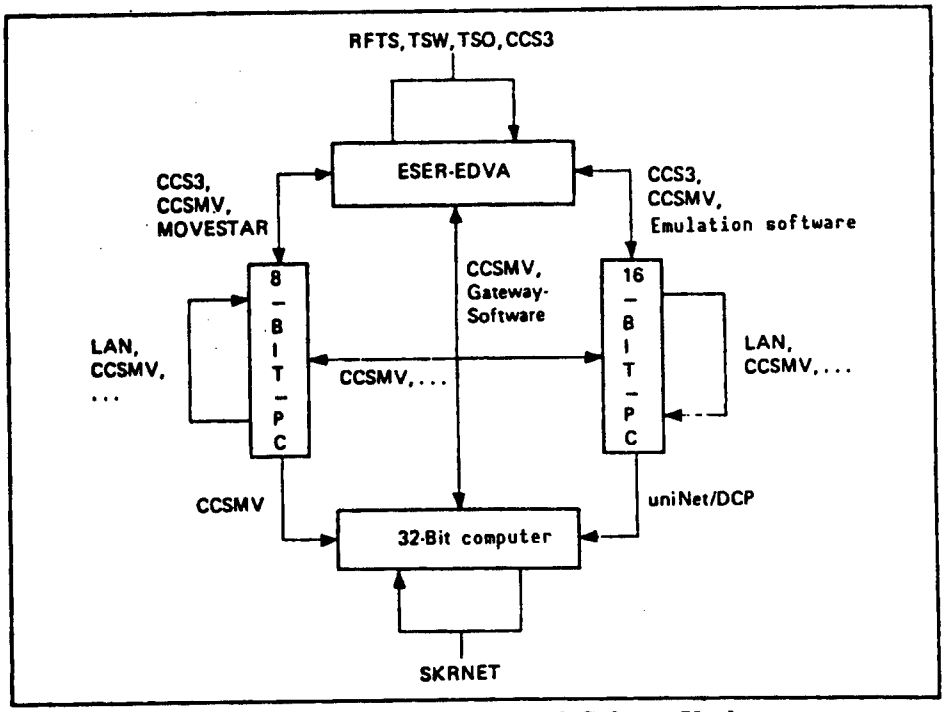

Figure 3. Overview of Network Software Used

A procedure for remote starting and terminating of the CCSMV server process on the 32-bit computer side from any SVM terminal is available to those responsible for the system. Instead of the CCSMV server process any user process can also be started remotely and used for interactive work on the 32-bit computer from the ESER terminal (e.g. for sending or reading messages, transfer to ESER and subsequent transmission via SPOOL).

The two modi were introduced for technological reasons to exclude errors in the work of the general users (e.g. no CCSMV/32 server process restart after termination of the interactive work or blocking of the one available line by extensive interactive work of a user).

Since the collectively used host computers frequently require a transfer which is considerably greater than with a PC is connected, this solution can be used only temporarily. Further development must meet two primary criteria:

— parallel usability of the physical connection for several logical connections, and
— a considerably higher baud rate.

/7/ describes a suitable solution constituting a gateway between ESER/SVM and K 1840/SVP which provides file transfer, user communication, and remote printer output while meeting the above criteria.

However, since the KIF-Controller hardware basis described in this solution cannot be widely used at present, the VEB LfA is working on the development of an alternative version on LAN basis using wide available assemblies. A publication on this topic is in preparation.

Fig. 3 shows a summary of the software used for the in-house network.

The solutions uniNet/DCP and CCSMV described are already used for the in-house network in the VEB LfA.

The gateway connection on a LAN basis is in the implementation phase and is expected to be in full use in early 1989.

For the more distant future, a transfer of uniNet to ESER-EDVA is under consideration. In addition, enhancement of the gateway software by a multiple address support is planned to fully utilize the LAN hardware features.

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Survey of Computer Products From GDR's ROBOTRON Combine

23020007 East Berlin FEINGERAETEMECHANIK in German No 9,1988 pp 387-392

[Article by Dr. W. Schulze: "Computer Technology From the VEB Combine Robotron—A Survey"]

[Text] The electronic computer technology and its application have seen a rapid and diverse development for a number of years, and this process continues. It is based on the constant interaction between the information processing requirements (which are also developing) and the concrete possibilities of meeting such demands as they are provided by science and technology at a given moment. This interaction is basically focused on those requirements which would ensure the maximum possible progress of production forces in the respective phase. At present, these are primarily requirements which affect the design and construction of products in its widest sense as well as their manufacture. As a consequence, computer-assisted design and construction (CAD) as well as computer-assisted and computer-integrated production control and manufacture (CAM, CIM) are currently among the most advanced applications of electronic computer technologies. They are based on a level of development for computer resources which is characterized by two features as seen from the user:

— workplace orientation, i.e., integration of access to the electronic computer technology into the workplace of the person who processes information, and
— integration of data processing and data communication, i.e. provision of closed automation solutions for information processing tasks in its widest sense (as a logical result of workplace orientation).

These features basically require that technical resources for information processing are available,

— whose decentralized use at the workplace is possible economically (price/performance ratio) and with appropriate utilization conditions (space requirements, environmental requirements)
— which are sufficiently capable of handling a variety of data processing categories
— which the user can be reasonably expected to programm and and operate
— for which task-specific peripheral devices and resources for man-machine communication (e.g., graphic I/O devices, adapted keyboards) are available, and
— which can be interconnected and networked.

Main Development Trends for Electronic Data Processing Installations and Decentralized Data Technology

The VEB Combine Robotron has directed the development and production of data processing technology to meeting the above mentioned requirements. There are two main trends:

— electronic data processing installations (EDVA)
— decentralized data technology devices.

The main line EDVA of the VEB Combine Robotron is fully integrated into the multi-national agreement on the Uniform System of Electronic Computer Technology (ESER) of CEMA. It is the objective that the participating countries share the development and production of a family (graduated with regard to performance) of electronic data processing installations based on binding standards (interfaces) and agreements. As part of this project, the VEB Combine Robotron is concentrating on host computers with medium capacity, selected peripheral devices, as well as basic software (operating systems and machine-oriented software) for the corresponding EDVA. While in the past, the EDVA, series 1 and 2 of the ESER with the numbers EC 1040, EC 1055, EC 1055 M, and EC 1056 were used relatively widely in the economiy of the GDR, but also in the USSR and other CEMA countries, it is now the electronic data processing system EC 1056 that provides a model of the series 3 of ESER which allows the development of new or more effective application solutions such as CAD/CAM systems, multi-computer systems and teleprocessing systems due to its better performance and better utilization characteristics. Compared to its predecessors, the EC 1057 system is characterized by its higher operating speed (addition capability is possible by configuring it as a dual processor and dual computer system) and a larger capacity of the main memory on the one hand and new and more sophisticated peripheral devices as well as a considerably improved service friendliness on the other hand. (For basic technical data see table 1). In addition to the device components the operating systems available for the system (with a virtual address space—SVS—and for virtual machines—SVM—provide for new and improved application properties.

Like its predecessors, the EC 1057 can be used in the traditional batch mode (simplified: the processing tasks to be performed are handed over at the computer center "counter"), but allows remote data processing and dialog operation via terminals from the user workplace which is far superior to the older models, the latter in particular for sophisticated tasks such as computer-assisted design (ESER-CAD). This makes it possible to meet the user requirements initially mentioned in the field of information processing for some of the tasks. For many other requirements, including in particular those referring to office automation, but als for sophisticated CAD-tasks and tasks related to process-oriented production control this is less the case since, for instance, the price/performance ratio, the utilization conditions required, or the communication possibilities with the environment (user or process) present an obstacle with the present EDVA generation. At present, the devices of the so-called decentralized data technology provide a satisfactory solution in this respect.

They are devices which are generally designed for use directly at the user workplace.

The practical possibility of developing and producing devices of this category came as a result of the scientific and technical progress in the mid-seventies.

Their technical basis includes primarily families of highly integrated and very highly integrated circuits with microprocessors, memories, and logic circuits. In the VEB Combine Robotron the concept of a first product program "Decentralized Data Technology" was first submitted in 1977. Since the late seventies, the devices and systems of this category have been developed and produced in the CEMA countries as part of a system which is coordinated by a multi-lateral agreement, the system of microcomputer technology (SKR) (even though it should be mentioned that the extent of coordination and in particular of division of labor is less than for ESER).

For a general classification of the devices and systems of decentralized data technology by their performance characteristics the number of bits (binary number; smallest unit of information) processed in parallel in a device can be used.

Table 1. Technical Parameters of the Electronic Data Processing Systems EC 1057

Component/Parameter	Technical Data	Number	Production
Central Processing Unit		EC 2157	Robotron
Operational speed	1 million operations/s		
Processing width	8 bytes dual;1 byte decimal		
Main memory capacity	4, 8, 16 MByte		
Cycle time	540 ns		
Operating and Service Processor		EC 1557	Robotron
Keyboard	number: 2		
Screen	type: alphanumeric		
Disk drive	number: max. 4; type: 8 inch		
Printer	dot-matrix printer; 100 characters/s		
Peripheral Devices			
Disk storage			
Hard disk storage	317 MByte	EC 5063	VRB
Moving head disk	2x100 bytes	EC 5067.02	VRB
	100 MByte	EC 5066.M	VRB
Magnetic tape device	800/1600 bit/inch	EC 5002.03M	VEB CZ
	800/1600 bit/inch	EC 5002.06	VEB CZ
	1600/6250 bit/inch	EC 5027.01	VRB/USSR
I/O devices			
Floppy disk I/O	8 inch diskettes	EC 5075	CSSR
Punched card reader	1200 cards/min	EC 6019.M	USSR
station	2 punched tape readers, 2 magnetic cassette tape devices	EC 7902.M	Robotron
Printer technology			
Laser printer	20 pages A4/min	EC 7230	Robotron
Chain printer	900-1500 lines/min	EC 7039.M1	CSSR
Graphic peripherals			
Interactive graphic terminal	graphic workstation;direct connection	EC 7945.12	Robotron
Graphic tablet	Format A4,resolution .1 mm	EC 7945.13	Robotron
Dot-matrix printer	graphics	EC 7084	Robotron
capability Digitizer	format A0 resolution	EC 7945.14	Robotron
Plotter	.01 mm format A0	EC 7907.02 M1	CSSR
Monitor technology			
Monitor system	direct data capture and dialog processing, close and remote installation	EC 7920	Robotron
Multiplexors			
Remote data processing	multiplex control processor,max. 128 lines	EC 8408 M	Robotron
Telecommunications	max. 252 lines	EC 8371.01	VRP processor
Operating systems			
SVS 7.1, Mod.1	system of virtual memories		Robotron
SVM 3.3, Mod. 1	system of virtual machines		

This parameter also identifies to a certain extent the state of development in this field. So far, 8, 16, and 32 bit computers have gained international significance. Increasing the number of parallel processed bits has a number of advantages. They include, for instance, an increase in the processing speed of the computer core and the processing performance of the overall system, an increase in the extent of the directly addressable main memory area, and the man-machine communication. Finally, novel application possibilities are opened up and additional areas of applications are explored.

2. Decentralized Data Technology Devices

The VEB combine Robotron produces decentralized data technology devices and systems in all three performance categories listed. The 8-bit technology currently covers the following devices:

— office computer robotron A 5120 (production to be discontinued in 1988);
— personal computer robotron 1715; in 1988 supplemented and replaced by personal computer robotron 1715 W;
— switching terminal robotron K 8924 (used in financial transactions, traffic and in cultural institutions);
— operating data capture system robotron A 5222 (production to be discontinued in 1988)

At present, the 16-bit systems still include the minicomputer system K1630 with the application complexes data and information system robotron A 6422, process computer system robotron A 6492, and the image processing systems robotron A 6471, A 6472, and A6473 which are derived from it. All systems mentioned will no longer be produced after 1988.

Table 2. Technical Parameters of the Personal Computer Robotron 1715 W

Component	Parameter
System unit	
Central processor	8-bit processing width IC U880; cycle frequency 4 MHz
Main memory	256 Kbyte
Disk drives	2; 5.25 inch
Monitor	screen with 24 lines x 80 characters; loadable character generators
Keyboard	for specific countries
Peripheral devices	various printers and typewriters, Controller for ROLANET1 and SCOMLAN
Operating system	SCP, version 3.0

Table 3. Technical Parameters of the Workstation Computer robotron A 7150

Component	Parameter
System	
Central processor	16-bit processing width IC K 1810 WM 86
Main memory	256-768 Kbyte
Disk drives	2; 5.25 inch
Hard disk storage	5.25 inch; 30-50 Mbyte
Keyboard	1 or 2 character sets
Monitor technology	Monochromatic alphanumeric screen (24 lines x 80 characters);color and monochromatic graphics screen resolution (640 x 480 pixels)
Peripheral devices	various printers, graphics tablet, plotter, digitizers
Operating systems	DCP; SCP 1700; BOS 1810 (real time operation) MUTOS 1700 (time sharing operation)

At present and in the foreseeable future, production of 16-bit technology is focussed on the

— workstation computer robotron A 7150
— personal computer robotron EC 1834.

Another 16-bit system offered is the operating data capture system robotron A 5230 (replaces the 8-bit system A 5222) with clearly improved performance parameters.

The current flagship of the VEB combine Robotron among the decentralized data technology devices is the 32-bit super minicomputer RVS robotron K 1840 which entered production in 1987. This system was SKR-checked and included in SKR in 1988 (model no. CM 1710).

Tables 2 to 5 summarize the basic technical parameters for personal computer robotron 1715 W, workstation computer A 7150, personal computer robotron EC 1834, and super minicomputer RVS robotron K 1840. Table 6 provides an overview of technical data and possible connections of the major peripheral devices from the combine production which are used in connection with decentralized data technology systems of the combine Robotron.

Table 4. Technical Parameters of the Personal Computer robotron EC 1834

Component	Parameter
System	
Central processor	16-bit processing width, IC K 1810 WM 86
Main memory	256 Kbyte; 640 Kbyte
Disk drives	2; 5.25 inch
Hard disk storage	5.25 inch; 30-50 Mbyte
Keyboard1 or 2 character sets	
Monitor technology	monochromatic alphanumeric screen (24 lines x 80 characters)color and monochromatic graphics screen (resolution 640 x 480 pixels)
Peripheral devices	various printers, graphics tablet, plotter,digitizers
Operating systems DCP; MUTOS 7500	

Table 5. Technical Parameters of the Super Minicomputer RVS robotron K 1840

Component-/Parameter	Technical Data	Model	Production
Central Processing		CPU Unit K 2810	
Operational speed	1.1 million operations		
Processing width	32 bits		
Virtual addressing	4 Gbyte		
Area I/O	max. 13.3 throughput Mbyte/s		
Main memory capacity and main memory		MEM K 3581.10 MEME K35.81.11	Robotron
Expansion capability	max. 16 Mbyte		
Cycle Time	800 ns		
Peripheral devices			
Disk storage			
Hard disk storage	160 MByte	K 5880	Robotron
Moving head disk	200 Mbyte	CM 5416	VRB
CM 5404	100 Mbyte VRB		
Magnetic tape device			
	1.9m/s; 800/1600 bit/inch	CM 5306	VRB
	.63 m/s; 800/1600 bit/inch	CM 5308	VRB
	1.14 m/s; 800/1600 bit/inch	CM 5309	VRB
Printer technology			
Line printer	drum printer to 900 lines/min	VT 270xx	UVR
	chain printer to 600 lines/min	VT 23x00	UVR
Dot-matrix printer	graphics capability to 165 characters/s	K 63xx	Robotron
Graphics peripherals			
Interactive graphic terminal	graphic workstation, direct connection	K 8918	Robotron
Digitizer	high resolution, A0 format	K 6404.20	Robotron
Plotter	A2 format, 8 colors	K 6411	Robotron
Monitor technology			
alphanumeric terminal	24 lines x 80 characters	K 8911.80	Robotron
Data processing peripherals			
Data transmission device	19.2 KBaud to 5 km; 1.2 KBaud to 30 km	K 8172	Robotron
Modem	synchronous transmission to 2.4 KBaud	VM 2400	Nachrichten-elektronik
	asynchronous transmission to 1.2 KBaud	TAM 1200	UVR
LAN controller	connection to ROLANET-2	K 8681	Robotron

Operating systems SVP 1800	multi-user operation, multi-program operation, virtual memeroy technology	Robotron
MUTOS 1800	multi-user operation, multi-program operation, interactive participants operation	

Table 6. Technical Parameters and Possible Connections of Selected Peripheral Devices to the Major Decentralized Data Technology Systems of the VEB Combine Robotron

Peripheral Keyboards	**Model**	**Parameters**	**Connection to Device**
	Number	K76xx	PC, AC, EC
Monitors	K72xx	alphanumeric: 24 lines x 80 characters; graphics:640 x 480 pixel	PC, AC, EC;AC, EC
Screen terminals	K 8911	alphanumeric: 24 lines x 80 character	RVS
	K 8918	graphics: 640 x 480 pixel; graphics tablet	RVS
Disk drives	K 56xx	5.25 inch; to 1.2 MByte	PC, AC, EC
Hard disk storage	K 55xx	to 160 MByte	AC, EC; RVS
Serial printer	K631x	graphics capability; 100 characters/s	PC, AC, EC; RVS
	K 632x	graphics capability	PC, AC, EC, RVS
	SD 1152	letter quality, 40 characters/s	AC, EC, RVS
Digitizers	K 640x	to A0 format	AC, EC, RVS
Plotters	K 641x	to format A2, up to 8 colors	AC, EC

Explanation of abbreviations: PC - Personal Computer 1715 W; AC - Workstation Computer robotron A 7150; EC - Personal Computer robotron EC 1834; RVS - Super Minicomputer RVS robotron K 1840

Table 7. Standard Software for Decentralized Data Technology Devices and System of the VEB Combine Robotron (Selection)

Product	**Contents**	**Can be run on Name**
TEXT	word processing; menu-driven; universal application	PC
TEXT 40/M16	general word processing	AC, EC
KP/M8	spreadsheet program (calculation of tables)	PC
TABCALC/M16	spreadsheet program	AC, EC
REDABAS/ M8 or M16 system	relational data base	PC or AC, EC
ALLDBS	data base operating system	RVS
DABA 32	data base operating system	RVS
AIDOS/M8 or M16	information search for text information of variable	AC, EC
PCGRAF/M8	presentation graphics	PC
GRAFIC/M16	presentation graphics	AC, EC
NUMATH/M8 or /M16	processes of numerical mathematics	PC, AC, EC
MULTICOMP	integrated package (wordprocessing, spreadsheet, database management, presentation graphics, office functions)	AC, EC

For explanation of abbreviations see Table 6.

Tables 2 to 6 show the main areas of application for the respective devices and systems. The personal computer robotron 1715 W, for instance, is primarily suited for automating wordprocessing tasks (posting, invoicing, spreadsheet calculations) and for work with files and databases which are limited in size, and for solving simple computer-assisted design tasks. In addition, it is used as a terminal for ESER and SKR computers. The workstation computer robotron A 7150 and personal computer EC 1834 are equally suitable for office streamlining tasks (including wordprocessing), planning, cost accounting, line information, for medium-difficulty computer-assisted design tasks, for technical and scientific calculations, as well as a terminal for higher-level computers. For this computer, the tasks mentioned should be considerably more demanding than for the 8-bit personal computer robotron 1715.

Compared to the personal computer robotron EC 1834 the workstation computer A 7150 has the advantage of having full real-time capability (possibility of communicating with running technical-technological and other processes in real time) which makes it highly suitable for use in computer-assisted production control and production and as part of comprehensive CAD/CAM-CIM systems.

The super minicomputer RVS robotron K 1840 has the prerequisites for solving sophisticated data processing tasks in a wide variety of categories, primarily, however, tasks of graphic data processing up to 3-D graphics), from comprehensive tasks of computer-assisted design to computer-integrated manufacturing, work with large databases, simulation of complicated processes and carrying out of scientific-technical calculations. The possibility of connecting several systems via the fast computer network ROLANET-2 increases the computer performance available at the user workstation even more.

The possibility of using decentralized data technology devices and systems for specific task categories depends both on the device properties and the available software. When computer resources are used primarily for workstations the software (in particular user software) must be

—readily available at a reasonable cost,
—easily usable and
—easy to modify (adaptable to changing tasks)

Table 8. Higher-Level Programming Languages for the Major Decentralized Data Technology Systems from the VEB Combine Robotron

Higher Programming Language	Can be used for
BASIC	PC, EC, EC
COBOL	AC, EC
FORTRAN 77	PC, AC, EC, RVS
PASCAL	PC, AC, EC
C	AC, EC, RVS

For explanation of abbreviations see Table 6.

At present, these requirements can best be met by making available standard software for typical data processing tasks and application packages (for specific industries and for general application).

Typical data processing tasks for which individual standard software programs or standard software packages can be used are complexes such as

—wordprocessing
—spreadsheet calculations
—presentation graphics—data communication.

Application packages can be intended, for instance, for designing printed circuit boards, financial accounting of industrial firms, or seat reservation. Table 7 summarizes the available standard software for decentralized data technology devices and systems of the VEB combine Robotron (information application packages can be obtained directly from the software distribution units of the combine.)

The standard software and application packages can of course meet only part—even though a considerable part—of the user requirements.

The remainder still requires the development of software which is more or less specific for one task. However, this will usually have to be done by professional software developers. Table 8 lists the available higher-level programming languages which are required for the development of specific softaware for the decentralized data technology devices and systems discussed here.

In summary it can be said that the decentralized data technology devices and systems of the VEB combine Robotron can largely meet the requirements mentioned initially regarding computer resources for workstations. They make it possible to gradually support more and more workstations and tasks directly by computer resources.

However, implementation of this possibility makes it even more necessary to streamline and automate data communication, the flow of information, in addition to data processing in its stricter meaning. The data processing industry is meeting this challenge worldwide by creating the prerequisite for the establishment of computer networks.

3. Establishment of Computer Networks

To simplify matters here, a computer network is understood to mean the connection of computers via communication channels through which independent programms can be run. From a technical viewpoint, computer networks comprise

— the participating computers as so-called participants; They can be decentralized data technology devices and systems and EDVA.
— the communication medium (the communications channel); At present they range from telephone-type lines via coaxial cables and fiber optics to satellite transmission channels.
— coupling devices between the participants and the communications medium; Such coupling devices are required at the participant site (controller, interface processor, or similar) and at the communications medium site (transceiver).
— control component; It comprises primarily the software for controlling the work of the computer network.

Table 9. LAN-Controller Available for ROLANET-1 in 1988

Controller	Basic Device/Participant
LNC K 8622	PC
LNC K 8623	Minicomputer K 1630
LNC K 8624	AC
LNC K 8625	EC
LNC K 8621	Microcomputer K 1520

For explanation of abbreviations see Table 6.

Depending on the geographical size of the computer network we differentiate between local area networks (LAN) and wide area networks (WAN). At present, the VEB combine Robotron offers components for the establishment of the local networks ROLANET-1 and ROLANET-2. ROLANET-1 is an open, modular system. A common feature of the connectable participants is a device-specific intelligent interface control, the LAN-Controller which is software supported by an operating system supplement. Table 9 lists the types of LAN-Controllers (and thus the possible types of participants) which are currently being offered. Other types are under development. Each LAN-controller is connected with a coupling device at the communications medium which is configured as a bus, the transceiver. A coaxial cable is used as a communications medium, which can have a total length of 2,500 m with a maximum segment length of 500 m. Transmission speed on the bus is 500 Kbits/s.

ROLANET-2 whose components will be delivered starting in 1989 is a local computer network for sophisticated data processing problems where extremely high data transmission speeds are required, as for instance for complex tasks of computer-assisted design and computer-assisted production control. The bus transmission rate is 10 Mbits/s.

The establishment of such a local computer network is useful only in connection with high-performance participants like the super minicomputer RVS robotron K 1840.

Software Developed for Hotel Chains

25020025b Budapest
COMPUTERWORLD/SZAMITASTECHNIKA
in Hungarian No 19, 21 Sep 88 p 5

[Text] Two noteworthy developments were reported by the Adatrend Data Processing, Systems Programming and Computer Technological Small Cooperative.

Under the name Melior Tools, they are presenting an auxiliary program package at the exhibition which resolves the limits of the dBASE. It is well known that the screen planning of the popular data-base manager is somewhat difficult. The 50,000 forint, Hungarian-language tool kit considerably speeds up and facilitates both the screen display and the printing, data search and maintenance.

The development of a complete hotel information system required work of several orders greater magnitude. The extensive system, which could be built only at the display level for purposes of the exhibition, will know considerably more than its foreign competitors because it will collect and arrange not only reception information but—in an original manner—will put every single room of the hotel on a single line. Among others, waking calls, billing, security and phone use can thus be followed and guided with the online system. The domestically developed room electronics and expansible network has already aroused the attention of several hotels. For example, the Kenguru Hotel Chain, planned by Szelektiv Co., can represent a serious market even among them.

Because the Ministry of Commerce strongly supports such developments, the Adatrend Small Cooperative also has a good chance when bidding at other hotels. It is worth mentioning that they too converted the specialist group of a production cooperative in October 1986. The 15-member small cooperative is struggling today with precisely the same basic problems as most computer technological small enterprises: unfair curtailments by the state, the special tax, the lack of choices which developed as a result of the 25-thousand regulation and "nationalization of wealth." Strangely, these days even the profession makes the work of the small enterprises more difficult; for example, the Walton Ltd. which owns the exclusive commercial rights to Novell, with its prices widely judged to be impossible, is not certain to facilitate the further domestic expansion of the modern network.

This is only one of the reasons that Adatrend is also promoting the development of other network standards. The other reason is that they have found some which they consider even better than Novell for various purposes, including from the standpoint of their wallet.

In spite of the current slump on the hardware market, they plan to double their 179 million forint income of last year precisely from their software developments. In this they will hopefully be aided by their work on the development of the computer network at the National Saving Bank [OTP] and perhaps also the new plans in the Postal Bank [Postabank] which was also founded with their participation.

LASERS, SENSORS, OPTICS

GDR Device for Sensing Color, Surface Properties Described

23020009 East Berlin FEINGERAETETECHNIK
in German No 9, 1988 pp 399-401

[Article by Dr H.-J. Gerhard, F. Guenther, J. Sochurek of Zwickau Engineering College, Department of Electronic Automation Technology: "Sensor System for Recognizing Colors, Surface Properties and Workpiece Positions"]

[Text] In automation technology, in addition to the problems of integrating the sensor into the production

system, optimizing control, operability, and interference immunity, the problem of developing suitable, optimally universal sensors remains a top priority. In manual labor, the vast majority of information is registered visually. Accordingly, an increasing number of optical sensor systems are finding a place in automation projects[1]. Their most outstanding characteristic is their ability to quickly record a large amount of information without physical contact. The large amount of information requires an appropriate signal-processing capability, which often results in sensor systems with high material costs. In this article, we will present a relatively simple, reusable sensor system that is best suited for connection to optoelectronic components (sensor elements) and that enables several combinable modes of operation using microprocessor control. By linking information from several similar or different sensors, or by connecting multichannel sensors, relatively complicated recognition and monitoring problems can be solved. In addition to its modular design, the flexibility of sensor signal processing brings with it multivalence in the sensor system, interim memory options, knowledge acquisition capability and self-adaptation possibilities. The term "intelligent sensor" is presently gaining currency for this type of system.

1. Design of the Sensor System

Because of its modular design, the sensor system can be easily adapted to various recognition tasks. It comprises the following components: control computer, sensor driver circuit, sensor head, output unit and, if necessary, a power supply unit[2]. The sensor head is connected separately to the sensor drive, while the other components are arranged on printed circuit boards in standard dimensions (170 mm x 215 mm) and interconnected by a coupling bus (Figure 1).

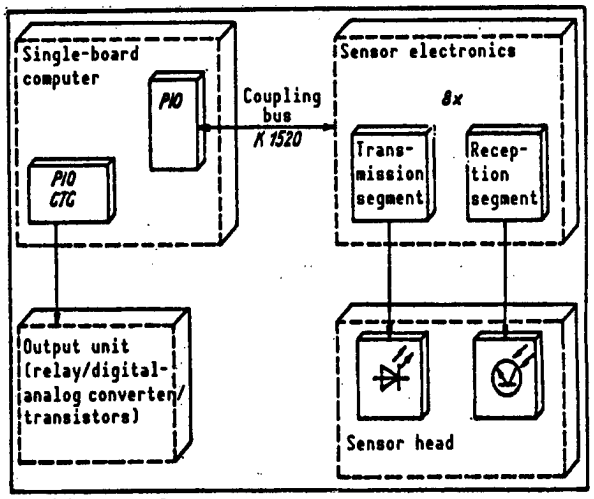

Figure 1. Overall Layout of the Sensor System

1.1. Control Computer

A single-board computer is used to control the sensor system. This can be either a special computer, the configuration of which is specially tailored to the requirements of sensor technology, or a central processing unit (CPU) from the K 1520 microcomputer system. The special microcomputer is characterized by the following fundamental attributes:

— Design according to U 880 microprocessor system
— Memory range: EPROM - 4 Kbytes, RAM - 2 Kbytes
— Two PIO and one CTC, accessible by plug connections
— One plug connection, lined and positioned compatible to the coupling bus of the K 1520 system
— Clock rate 2.5 MHz
— Supply voltage (+ 5 V).

The data flow of the special microcomputer is depicted in Figure 2. In order to start up new equipment or adjust the sensor system to the applicable recognition task, communication with the control computer is necessary. For this reason, the special microcomputer has circuitry components for directly connecting a keyboard, monitor and magnetic tape unit. A tested control program is put in the ROM so that the latter can be started up by a power-on-reset and the special microcomputer can be operated without peripherals. Adjusted sensor systems can be operated with a CPU as control computer, since its configuration is sufficient for many applications.

1.2. Sensor Driver Circuit

There are appropriate circuit options for driving the various sensors. A sensor driver circuit makes it possible to connect beam waveguides. Another circuitry variation, which is used, among other things, for surface and color recognition, is described in greater detail below (Figure 3). Via eight different channels, transmitters (light and infrared emitter diodes) can be activated and eight different measured signals can be received from sensor elements (phototransistors, photodiodes). Each transmitter channel comprises a monostabile multivibrator and a source of current, while each receiver channel comprises a preamplifier and a peak meter, which can also be operated as a sample-and-hold circuit. All the components can be alternately inserted, depending on requirements. For example, the monostabile multivibrator in the transmitter segment is needed only for intermittent operation, while the peak meter in the receiver segment makes it possible to store analog measured values in temporary memory, which is necessary for the simultaneous recording of measured values. This means several modes of operation for this sensor driver circuit, e.g., serial, parallel, intermittent and continuous operation. The control computer selects the channel using a decoder and an analog multiplexer. The peak meters are reset with an optic coupler, and the measured values are read into the control computer via an analog-digital converter.

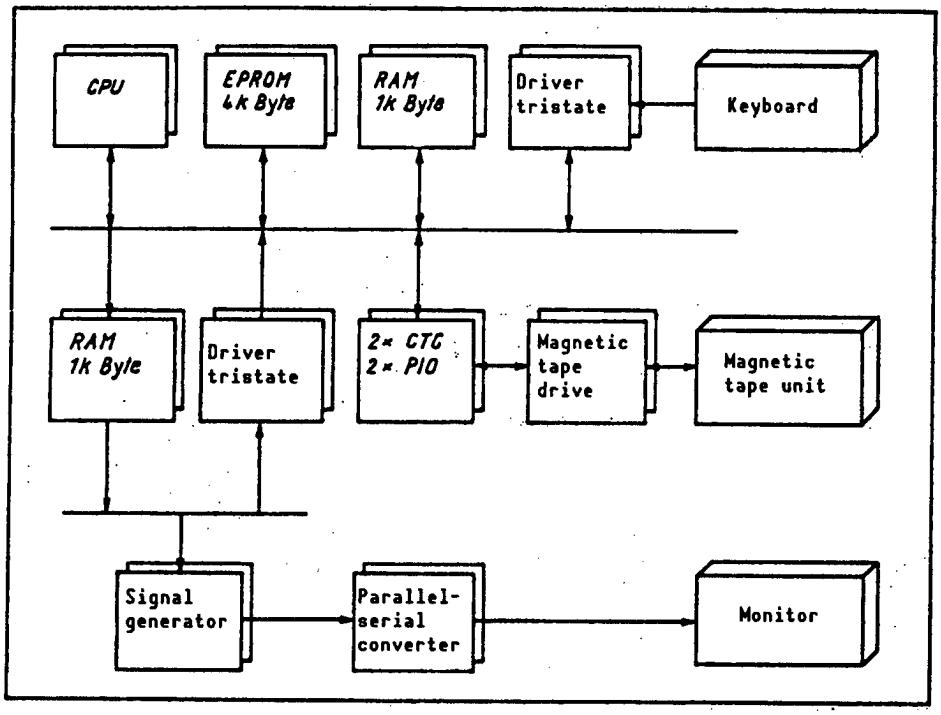

Figure 2. Data Flow of the Special Microcomputer

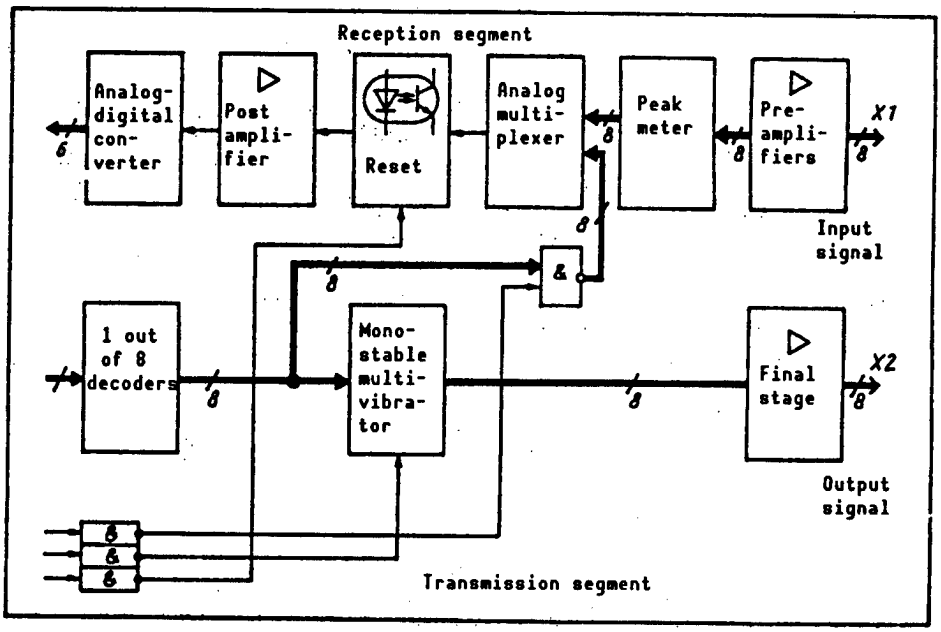

Figure 3. Examples of Applications

1.3. Output Unit

In order to output control signals to higher control units, various output units can be connected, depending on the application. An output unit for coupling with the PEA of an industrial robot control unit realizes a level translation from 5 V to 24 V or from 24 V to 5 V. In another variation, signals are transmitted for general control purposes using potential-free relay contacts, the switching state of which is additionally displayed by light-emitting diodes. In the opposite direction, external control of the sensor system is possible to a limited degree using these output units. Digital-analog converters and power transistors can also be used to output control signals.

1.4. Sensor Head

The sensor head serves to directly record measured values from the process being viewed, and is constructively adapted to the task at hand. A maximum of eight independent transmitters and receivers can be implemented in one sensor head or arranged at geometric intervals. Besides the software, the construction of the sensor head constitutes the most important modification for problem-specific application of the sensor system. Preamplification of the measured signals in the sensor head necessitates approximately a fivefold increase in volume, but this has proven beneficial in terms of minimizing interference on the transmission line to the driver circuit.

2. Examples of Applications

2.1. Recognition of Colors and Surface Properties

The color of a body depends on the spectrum of the light source and on the reflectance properties of its surface. Unevenness in the surface and reflections distort the perceived color of the body, thus making rapid, automatic registration of the absolute shade of color more difficult.

Based on these surface properties, it is quite possible to use the sensor system to recognize bodies on the basis of their surface. For many automated tasks, color recognition is sufficient. Color recognition according to the spectrum method is possible by illuminating the body with white light, followed by an analysis of the intensity of the reflected spectrum[3]. Generating white light and breaking down the reflected light into its spectral segments require relatively complicated optical systems. Color recognition using discrete optoelectronic components according to the multirange method is comparatively simple; with this method, the diffuse reflection of the basic color segments from the surface to be measured is evaluated. In the proposed sensor system, the body is serially irradiated with light of certain wavelengths, and each unit of remitted and reflected light is recorded by a receiver. The arrangement of the transmitters and of the receiver elements in the sensor head is determined according to the shape and distance of the surface to be measured. Figure 4 [not reproduced] shows a complete sensor system for color recognition, with preamplification of the measurement signals in the sensor head. The corresponding control program is started when the device is turned on, requires minimal user attention and is designed in such a way that up to eight different colors can be recognized. According to an analysis of potential applications, this number is adequate, and if necessary can be increased as far as the limit of the sensor system's resolution. The control program for color recognition begins with knowledge acquisition, whereby all the objects that are to be recognized must be fed into the sensor head. After knowledge acquisition, the user starts the inquiry program, which either runs cyclically or is started by keystroke or an external control signal.

The time from the beginning of the inquiry program to the point at which a control signal is ready is basically determined by the translation time of the analog-digital converter, and amounts to at least 30 ms when the C 520 is used. Recognition reliability and thus sensitivity are improved by averaging several measured values, which means an increase in the aforementioned time to 500 ms. Both processing times are applicable. Under conditions where time is not critical, however, the greater processing time should be used. The color resolution of the sensor system, i.e., the smallest distinguishable spectral range, is adjustable at the sensor driver circuit. For a small spectral range, large resolution is adjustable, so that differences in color that are scarcely perceptible even to the human eye can be recognized. The greater the spectral range to be recorded, the smaller the color resolution achieved, in keeping with the resolution capability of the analog-digital converter. As with all color recognition processes, the multirange process is sensitive to outside light, since it causes a change in the spectral composition and in the intensity of the illumination. Ideal conditions exist if the surface to be measured is completely obscured.

There must be at least a strong shadow effect. The possible distance between the sensor head and the body is fundamentally influenced by the degree of darkness and is no more than 20 mm.

2.2. Position Recognition of Workpieces

Each of the proposed sensor driver circuits contains eight transmission and reception channels, to which in the simplest configuration light barriers can be connected, which are operated according to the reflex or transmitted light principle. If the light barriers are arranged in significant positions at geometric intervals, different workpieces—or rather, their positions—can be recognized. Figure 5 [not reproduced] demonstrates this point by way of an example. Light barrier 5 signals the presence of the piece moved in the direction of the arrow, which triggers an inquiry cycle. Using light barriers 1 through 4, the position of the piece is determined. The sensor system is superior to standard hardware solutions because different switching states can be

achieved with 256 light barriers, the switching threshold of which is established through the software. The individual light barriers are also linked logically through the software, which means a high degree of flexibility with low material costs.

The different switching states are stored either through knowledge acquisition—as with color recognition—or through direct input into the control computer.

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New Automated Production Control Device Produced in GDR

23020028 East Berlin FEINGERAETETECHNIK in German No 10, 1988 pp 435-439

[Article by Graduate Engineer D. Reinicke; Graduate Engineer H. Priplata; Graduate Mathematician K. L. Moeller; and Graduate Engineer K. Spring, JENA Carl Zeiss Combine VEB: "The New Coordinate Measuring Device ZKM 01-250 CM—An Automatic Device for Production Control"]

[Text] In production engineering, microelectronics has brought about an innovative change that encompasses all sectors of the production process. Thus, for example, the CAD work station is superseding the drawing board; the NC axis is replacing the handwheel; and CNC coordinate measuring devices are supplementing customary measurement tools.

The designing of coordinate measuring devices must follow this development in connection with the use of devices for quality assurance in the production cycle. It must make new measurement tasks possible—for example, the efficient measuring of two-dimensional structures of templates in semiconductor manufacturing as well as the measurement of small precision-made workpieces from the field of microelectronics. These parts must be measured both as prototypes and also later in the manufacturing process, something which forces the manufacturer to develop appropriate measuring stations in order to be able to comply with the requisite dimensional accuracy and also keep within the measuring times available. The frequency of measuring tasks that must be performed in the metal-working industry is given as follows for the testing floor: 46 percent—lengths and diameters; 23 percent—positional variations; 12 percent—shape variations; 8 percent—toothings; 10 percent—free-forming surfaces; 1 percent—other.

From market trends, from user demands, and from experiences gained in the use of more than 600 of our two-coordinate measuring devices throughout the world, the following requirements were derived for the designing of the new coordinate measuring device ZKM 01-250 CM:

- Increasing the measurement accuracy because of rising quality demands
- Flexible adaptation to different measurement tasks
- Enhancing operator conveniences and automation of the measurement
- Objectification of the measurement
- Increasing the productivity of the measuring process
- Capability of integrating the measuring device into existing quality-assurance systems
- Taking into account internationally common acceptance conditions.

1. Structural Layout

The device concept takes into account the most desirable goals in the field of drive, sensor, and computer engineering by making optimal use of microelectronics. In detail, this includes:

- Controlled motor-operated drives for the x, y, and z axes
- Measuring range x = 250 mm, y = 125 mm, z = 200 mm
- Reduction of measurement uncertainty along the x and y measurement axes compared to the predecessor devices
- Incorporation of the means of height adjustment for the measuring head (z-axis) into the mensuration concept of the device, and the thereby requisite reducing of the angular error between the x-z and y-z axes (uncorrected, less than or equal to 5 ')
- Flexible adaptation to differing measuring tasks through the use of a visual-photograph CTV camera (monitor) and opto-electric sensing methods in conjunction with high-performance illumination equipment for transmitted and reflected light, as well as mechanical sensing of an object by the use of a 2D or 3D sampling system
- A sitting position for the operator
- Usability of the accessories for the previous ZKM line of products.

The new ZKM 01-250 CM differs substantially from its predecessor models in its realization of the above-mentioned desiderata. One notable feature is its construction as a floor-standing device with a separate electronics cabinet, which serves as an accommodation area for housing the computer, printer, and monitor. For easy observation of the measurement process the device was

equipped with a TV measuring head, and all the important control elements—for example, aperture and slit stops as well as the control console with its function keys and two control levers—were positioned within easy reach (Figure 1 omitted).

The new design dispensed with a swiveling capability on the part of the floor stand for the sake of improving the right-angularity between the measuring-head height adjustment (z-axis) and the x and y measuring-table axes. Through determining the movement of the measuring head by means of a high-resolution measuring system, all the necessary conditions are satisfied for incorporating the z-axis into the mensuration concept of the device. Other elements essential to high measurement accuracies, in addition to a suitable device design with respect to measurement engineering, are the quality of the guidance system and the rigidity of the subassemblies. Because of the good positioning of the precision scales, comparator errors are very largely avoided (strict adherence to the Abbe comparator principle in the z-direction). For the first time, hardened and lapped precision runners are being used as table tracks for the ball antifriction slideways or roller slide bars of the carriages on the x-y measuring table. They have a higher static and dynamic load-bearing capacity than the former cast-iron table tracks and thus give the measuring slide mechanism greater security against overloading (for example, upon the mounting of heavy test objects). The load-balanced z-carriage as an accommodation unit for the TV measuring head and the sampling equipment grips onto a lapped precision runner attached to the floor stand, and it is guided along this runner by high-precision ball bearings.

Speed-governed dc motors in conjunction with friction-tight motion sensors are used for driving the carriages. In line with the differing conditions at the different measurement axes a taut-band drive with a straight open band is provided for driving the carriages of the measuring table, and a band drive with a closed band guided via a driving roller and counter-roller is used for driving the z-carriage. In both cases the motor speed is reduced by means of worm gears. The drive units are characterized by substantial smoothness of running, with their operating being jerk-free and jolt-free due to the computer-controlled startup and braking processes. In this way internally generated device vibrations are avoided and the necessary conditions are created for minimal measurement uncertainties even when the device is operated in the dynamic mode.

The most important structural unit for measurement execution is the optical measuring head that is fitted out with a TV camera (Figure 2). This furnishes on a monitor a magnified and easily viewable measurement image that lies within the "field of vision" of the operator. An easy switching of the image used for the measurement over to a general-view image five times larger (approximately equal to 18.3 x 13.7 mm^2 in the measurement plane) facilitates an orientation to the object to be measured. In using visual-photography measurement procedures, reticle slide-in units can be inserted in a familiar way into the intermediate image plane of the measuring head for the purpose of object sensing, shape comparison, and angle measurement. Moreover the newly developed opto-electronic measuring device KKR is available as an alternate slide-in unit.

2. Hardware and Software

The electronics and software form an inseparable element of the device. Whereas the capability of the predecessor device ZKM 01-250 C was governed largely electronically by the display units AE 100 or AE 101, the capability and applicability of the new device has been steeply increased by its new electronics. By building on the time-tested quality of its mechanics and optics it ensures superior final parameters because of

- An increase in accuracy through correction of systematic device errors
- Execution of objectified measuring processes
- Greater operator conveniences through motorization and automatic control of the equipment
- The possibility of automated measurements.

This has led to an enlargement in the quantity of information involved, since in addition to control and data-acquisition tasks, process monitoring as well must be increasingly taken into consideration. The processing of information becomes a predominant element in the device development. Beginning with the elaboration of a control interface and a suitable operating technology, the content, acquisition, and processing of the separate items of information must all be linked together to form a comprehensive total package that is still flexible on the basis of modular subassemblies.

In line with these requirements, the hardware and software of the ZKM 01-250 CM were modularly designed. Figure 3 shows the main software and hardware groups for the measuring and analyzing process of the ZKM. The device electronics is accommodated in a desktop cabinet and consists of several coupled microcomputers. The overall functions are realized through the interaction of the separate subassemblies, with the inclusion of the control and evaluation computer. The following control functions are available:

- Positioning simultaneously along three axes by means of two control sticks or via the control and evaluation computer
- Static measuring
- Dynamic measuring with the 2D sampling system, KKR, Renishaw probe
- Optical scanning with KKR
- Mechanical scanning with 2D sampling system
- Data generation
- Position display (0.1 μm resolution)
- Correction for systematic device errors and temperature
- Monitoring the functional units (for final positions, mishaps)

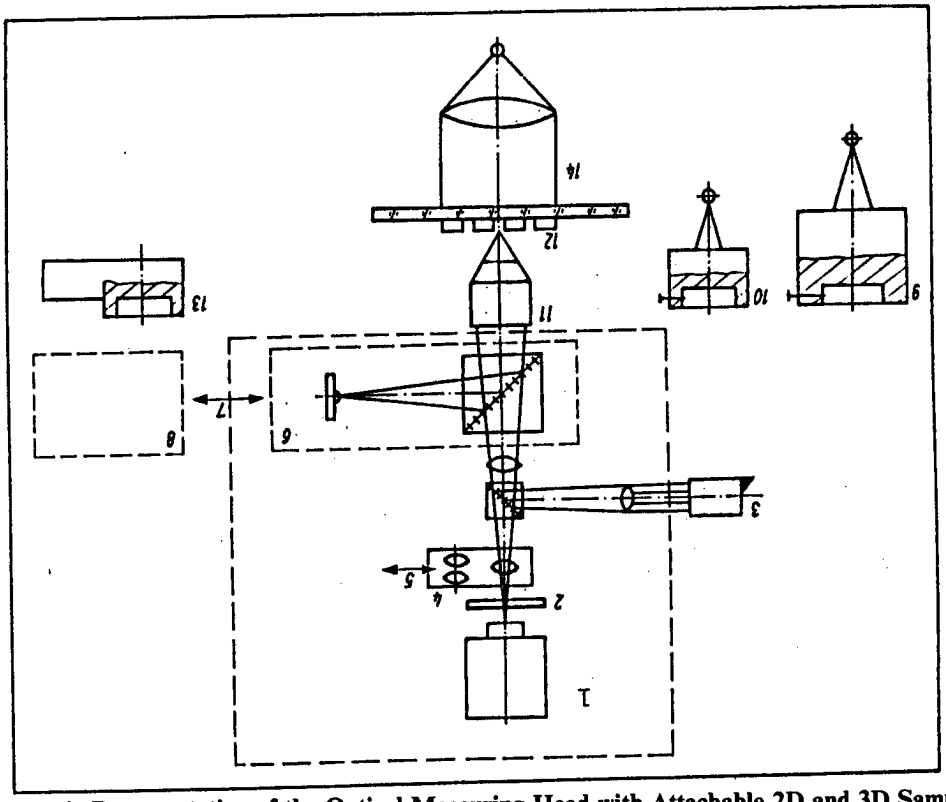

Figure 2. Schematic Representation of the Optical Measuring Head with Attachable 2D and 3D Sampling System

Key:
1. Television camera
2. Filter
3. Fiber-optic cable for coaxial direct light (bright field)
4. Motor-driven magnification changer for general-view or measurement image (β = 0.7 or 3.5)
5. Slidable
6. KKR (FEM [photoelectric measuring device])
7. Reticle slide-in units for all ZKM types
8. Same as 7.
9. 3D sampling system
10. 2D sampling system
11. Objective (1; 1.5; 3; 10; (20) x)
12. Object to be measured
13. External reflected-light illumination apparatus (objective 5 x) bright-field/dark-field
14. Transmitted-light illumination

- Generation of the characteristics for the control levers in accordance with preselected sensing rate
- Generation of the characteristic for the drive subassemblies to ensure jerk-free acceleration.

Here, in addition to communication to the external 16-bit computer the device electronics also establishes the identity of the control keys, generates the data, and energizes the position displays.

One important task is to incorporate the extensive correction features by means of which job-sequence errors, measuring-system errors, and departures of the axes from the perpendicular (cartesian coordinate system in three axes) are corrected.

Upon the installation of the device at the premises of the customer the device errors are determined by calibration standards and are stored.

On the basis of this a comprehensive correction matrix is calculated that among other things ensures the following device parameters:

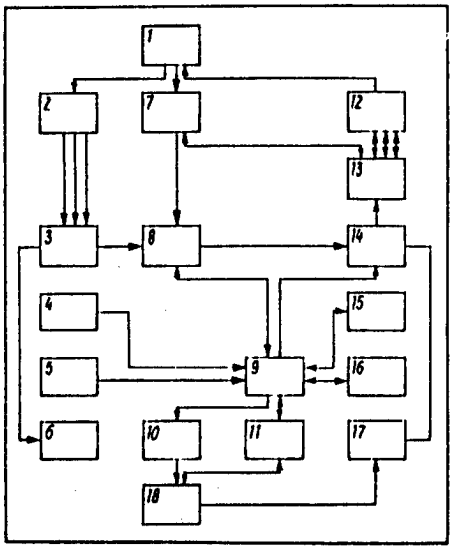

Figure 3. Main Software and Hardware Groups

- Departure from right-angularity between z and x-y less than or equal to 2"
- Departure from right-angularity between x and y less than or equal to 1".

With that, associations can be made among measurement values acquired in different planes, which permits the solving of 3D problems.

The speed-regulated point-to-point/linear-path control system ensures a positioning accuracy smaller than 10 µm per axis. Available are positioning speeds of up to 30 mm/s and measuring speeds between 0.5 and 10 mm/s, depending on the sampling system being used. A monitoring of the mechanical sampling systems provides protection against mishaps. It identifies the sampling system used in each case, controls the measurement process, triggers the data generation, determines the probe displacement of the 2D sampling system, and carries out the scanning function. This function, with its two sampling systems (optical: KKR; mechanical: 2D sampling system), represents the highest stage of development of the control system. With this measuring method, measurement points can be collected continuously in one direction (optical) or along any given contour. With that and in conjunction with the software of the control and evaluation computer the planned degree of automation is achieved.

The evaluation and control computer AC A7150 is given an enhanced functional capacity in comparison to predecessor devices. Requests can be made to the operating system that are practically possible only with the use of a multitask real-time operating system. This concerns the processing and editing of the control commands, which as commands are to be delivered to the computer as input and which also are passed on as control status information by the microcomputers of the control electronics. These requests approximate a process control and are handled by the operating system BOS 1810 of the Robotron Combine (compatible with the operating system iRMX86 (C) of the Intel Corporation). By making available analog operating systems for the ESER-PC, the implementation of evaluation and control processes on corresponding computers is provided for.

3. Possible Applications

The automatic version of the ZKM 01-250 CM presented here considerably enlarges the application possibilities. The measurements that can be executed are shown schematically in Figure 4. The design provides for two differing modes of operation:

- Manual measuring by actuating the control levers
- Automatic measuring with the use of programs.

Comparing the two operating modes makes clear the high level achieved from this further development of the ZKM product series.

In manual measuring, the executing by motor drives of movements along the x and y axes along with the use of the control levers considerably facilitates the moving of the two carriages and the z-slideway into desired positions. Depending on the measuring method selected, the measurement values can be taken either statically or dynamically (objectified). Optical measurements have already been successfully carried out using the photoelectric measuring device FEM. Thus it is possible to collect both static and dynamic measurement values, and in this connection it has proved possible to measure to advantage structures of like orientation above all.

For automatic measuring the opto-lectronic measurement device KKR was developed, because it fulfills the necessary condition of direction-independent sensing. This device, called a circle-annulus sensor (KKR), is likewise housed in a slide-in unit. This sensor is characterized by the following features:

- Direction-independent sensing
- Reliable dynamic taking of measurement values
- Objectified sensing
- Scanning of complicated structures

The advantages of the KKR also become clear in consideration of its large range of applications. Thus in transmitted light practically all structures dealt with can be measured, above all those that cannot be subjected to mechanical sensing. In reflected light, measurements can be carried out on objects that reflect well, with a directed reflection and good contrast.

For motor-controlled or automatic measuring it was necessary to provide the mechanical 2D sampling system with one additional degree of freedom in the z-direction, in order to protect the probe from damage. With that the

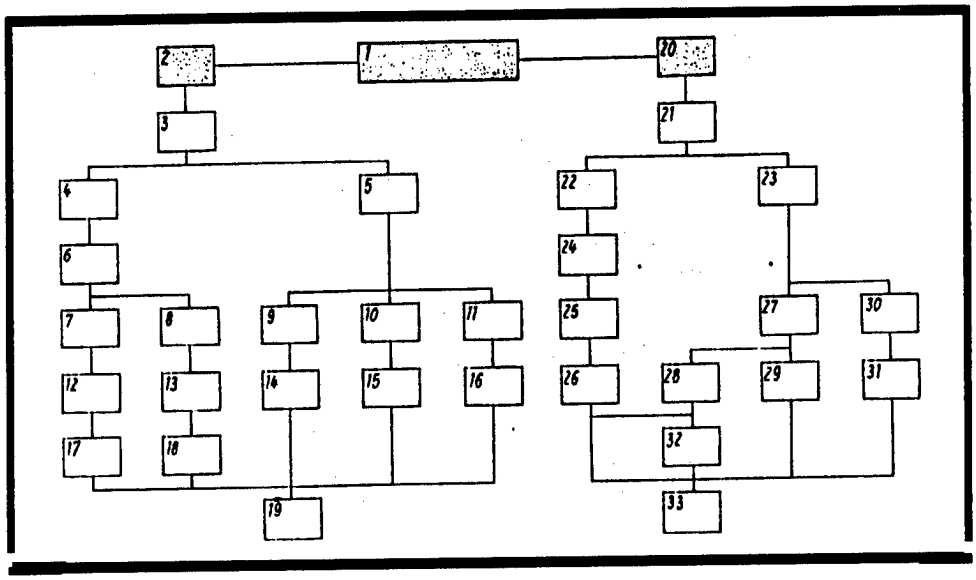

Figure 4. Schematic Representation of Usable Measuring Methods With the ZKM 01-250 CM by the Main Loops of Manual and Automatic Measuring

Key:
1. Measurement possibilities
2. Manual measuring
3. Control levers
4. Optical measuring
5. Mechanical measuring
6. Monitor
7. Static measuring
8. Dynamic measuring
9. Dynamic measuring
10. Dynamic measuring
11. Static measuring
12. Slide-in measuring units
13. KKR
14. 2D sampling system
15. 3D sampling system
16. 2D sampling system
17. Interference line
18. Shadow imaging
19. Point measurement
20. Automatic measuring
21. Programs
22. Optical measuring
23. Mechanical measuring
24. Monitor
25. Dynamic measuring
26. KKR
27. Dynamic measuring
28. 2D probe
29. 3D probe
30. Static measuring
31. 2D probe
32. Scanning
33. Point

2D sampling system has the necessary qualifications for automatic point-by-point determination of the measurement values. All measurements in three dimensions and discontinuous 2D measurements (this applies to the performance of most measurement tasks) are carried out by means of this point-to-point control.

Measured objects that are complicated (for example, toothings, curved contours, and so forth) usually require many measurement points in order to pack in the form elements involved. Therefore a computer-controlled moving of the carriages along with a probe control (scanning) was provided. The principle of this type of scanning consists in the fact that in moving one or both carriages the sampling element (usually a ball-type probe) constantly touches the surface of the object to be measured in the sensing process. And the measurement value—a triad of coordinates for the center of the ball—is taken regularly, at certain approximately constant intervals. Figure 5 shows the sampling methods provided. For the user, this offers a broad field for performing a variety of measuring tasks that may arise.

The great accuracy of the individual measuring methods is due not merely to the high precision of the mechanical-optical subassemblies or of their interaction, but also to improvements arising from measurement-value corrections made on a software basis wherever required.

In using the optoelectric measuring device KKR for measuring 2D structures, a measurement uncertainty is achieved of plus or minus $(1.7 + 2.8 \times 10^{-6}L)$ in µm, when a 10-power lens was used. Investigations with the 2D measuring system gave uncertainties of plus or minus $(1.6 + 2.8 \times 10^{-6}L + 2 \times 10^{-6}H)$ in µm for a dynamic sensing of the measured object (L is measured length, H is height above the plane of the table, in mm).

Whereas no calibration of the KKR is required for the measurement of 2D structures by this device, the 2D measuring system is calibrated by means of an appropriate calibration standard (rectangularity standard or ring gauge). In subsequent measurements the correction values are taken into account on a software basis.

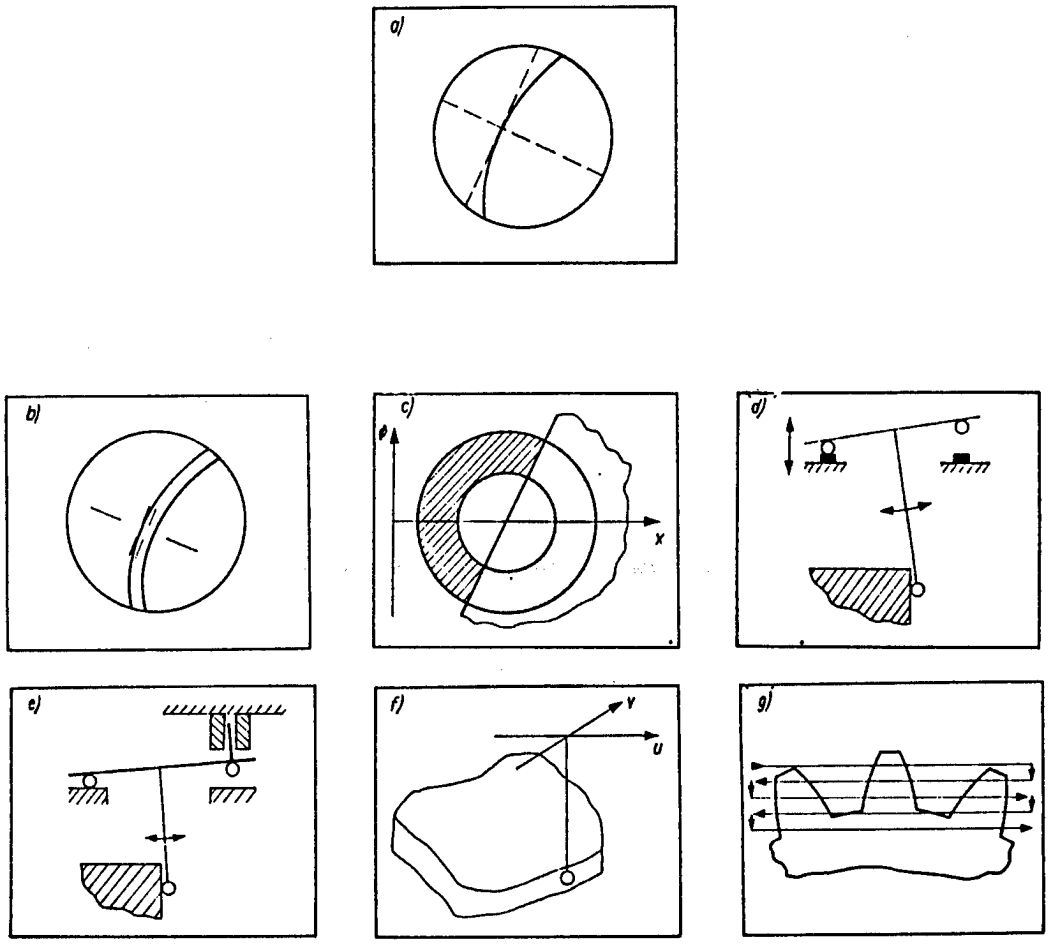

Figure 5. Sensing Principles

Key:
a)Optical sensing, shadow image, monitor (binocular), control levers, static
b)Optical sensing, interference line, monitor (binocular), control levers, static
c)Optical sensing, opto-electronic measuring device KKR, monitor, control levers, program, dynamic
d)Mechanical sensing, 3D probe, switching, control levers, program, dynamic
e)Mechanical sensing, 2D probe, measuring, control levers, program, dynamic, static
f)Optical sensing, scanning, opto-electronic measuring device KKR, program, automatic, dynamic
g)Mechanical sensing, scanning, 2D probe, measuring, control levers, automatic,

4. Evaluation

The software of the evaluation and control computer AC A 7140 is based on the MAUS program that has proved successful in predecessor devices; this program is a joint development by the Dresden Technical University and our combine.

This language concept has been partially revised in order to allow the setting of device parameters and the implementing of positioning and measurement commands with the aid of the notation, in order to ensure a high degree of automation in the repeat mode. This notation is based on a number of fixed indexed form elements (Table 1). Together with the modifications and pseudo-elements, they form the vocabulary of the language. The language syntax for evaluation and packing commands is:

$FE_i\ (FE_j\ (FE_k))\ (PS_l)\ (MOD(FE_m)) = FE_n...FE_s$

(FE is a form element; i, j, k...indices; PSE [as published] is a pseudo-element; MOD is a modifier).

Let us illustrate this general notation by some examples:

CR1 SC1 F = Q1-200 (circle with indication of the variation in shape under constraints, for example a fixed center)

CR1 CR2 CR3 F NM1 = Q1-200 (envelope, fitted, and penned circle with output of the desired-value/actual-value comparison relative to the fitted circle)

SL1 VR SL2 = P4 (T2D!) (straight line perpendicular to another line through a point)

SL1 SL2 = P10 CR4 (tangent from a point to a circle) (Table 1).

Table 1. MAUS 86—Form Elements

Form elements	Dimension	Symbols
Basic geometric elements		
Point	2 + 3	P
Straight line	2 + 3	SL
Circle	2 + 3	CR
Ellipse	2 + 3	EL
Distance	1	D
Angle	1	AN
Measurement point	2 + 3	Q/no-thing
Plane	3	PL
Sphere	3	SP
Cone	3	CO
Cylinder	3	CY
Pseudo-elements and auxiliary elements		
Direction	Auxiliary element for synthesis and control	
Desired value	Desired-actual comparison	NM
Constraint		SC
Form variation	Determination in line with	F
Position variation	ISO 1101	DTP
Coordinate system	Cartesian, polar, and cylindrical coordinates	CRD
Change of position		PCH
Calibration of probe		PR

In developing the ZKM 01-250 CM there was a need first of all to extend the language by means of elements for positioning and measurement; the commands needed for this are shown in Table 2. Finally, the functional scope was supplemented by commands for the setting and displaying of control and status parameters:

TS Input Set Reset Display.

With these commands and the definition of the measuring modes (STAT, DYN, OPTO, SCAN) the language is essentially transcribed. With the provided repeat mode for all commands of evaluation, control, and measurement as well as for the constant monitoring of the sensing process—where in a changing of the sampling system a basic status is automatically defined (mode of operation, sensing and measuring speed)—the degree of automation of the device has been essentially characterized. The above-mentioned speeds as well as other device parameters (probe length, lens magnification, and so forth) can be updated via a notation input. In the further development of the MAUS program system it was important to improve the operator's interface. Thus if the customer desires it, provision is made for generating all input and output words (command words, form-element designators, parameter words). With that an adaptation to national languages and to further developments in standards can be carried out at short notice.

Table 2. MAUS 86—Control Commands

Positioning, absolute/relative						
	Pi					
POSA						
	Qi					
POSR		Number		Number		Number
	x	Di	v	Di	z	Dk
Measuring of points in a given direction						
		+	x			
Pi = MES		-	v			
			z			
Qi						
		DR_i				
FE_k = i			Measuring by control lever			

Organizational commands, setting of control parameters			
	VPOS	NUMBER/NMES	NUMBER
	VMES	NUMBER/OBJ	NUMBER
INPUT	VPROB	NUMBER/LOAD	NUMBER
	TW	NUMBER/TM	NUMBER
	D/L	NUMBER	
SET	METR/INCH/CRDi/PM/dim		
TS	nn		
DYN/STAT/OPTO par. list			
DYN/STAT/SCAN par. list			

5. Summary

The design of ZKM 01-250 CM takes into account both the demands of the market for high capability in measurement engineering together with substantial operator

conveniences and also the trend that can be seen internationally toward objectification of the measuring process and toward a greater integration of computer engineering as the most important prerequisites for an automation of this process.

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SCIENCE & TECHNOLOGY POLICY

Goals, Funds of Hungarian Miskolc Industrial Center Discussed

25020013a Budapest DELTA IMPULZUS in Hungarian No 9, 1988 p 8

[Interview with Dr Zoltan Csomai, managing director, by Peter Szalay]

[Text] Borsod-Abauj-Zemplen Megye is the second most highly industrialized region of Hungary after Budapest. Nevertheless, the overly developed but structurally backward, distorted industry presents the greatest problem in the Megye. More than 60 percent of its products are processed outside of the Megye boundaries; the average lifespan of the products is fifteen years, and this corner of the country is facing the greatest difficulties with unemployment. Only a radical and rapid structural change can remedy the situation. The Northern-Hungarian Innovation Center (Park) [Stock] Co. [IC(P) Co.] was established at the end of last year to address these problems.

DELTA IMPULZUS: Dr Csomai, why did you select the classical stock company format—considered a white elephant in our modern industrial history?

Csomai: Naturally, the starting point was that the enterprise should support the establishment of new techniques, technologies and new type of organizational forms in the Megye. However, it became apparent already during the organizational period that Borsod-Abauj-Zemplen Megye with its more than 800 thousand inhabitants—which by the way provides 12 percent of the country's industrial production—has neither sufficient money nor open space with modern infrastructure, nor an adequate supply of managers to take upon itself this program without establishing a new enterprise. In contrast, the enterprises within and also outside of the Megye are gladly willing to spend for this purpose lesser sums amounting to a few million forints. The profit-oriented, outward looking mode of thinking can also be attractive to the banking sector. This calculation was successful: of the 54 shareholders, 26 are enterprises and institutions from outside of the Megye. Our shareholders include four megyes and the council of three cities, the Industrial Bank commissioned by the Ministry of Industry, the Investbank representing the OMFB [National Technical Development Committee]; other shareholders are Innofinance, the Budapest Bank, the Technical University of Heavy Industry and many enterprises representing the chemical, construction and heavy industries, energetics, the service industry, as well as trade and foreign trade. The 1 to 10 million share packets yielded a base capital of about 150 million. With the loans available on this basis, we will be able to declare ourselves to be one of the strongly capitalized enterprises in the region once all of the stock has been paid for. Namely, we will have the entire capital at our disposal only in 1989, this spring we have only 70 percent of it. However, if the company's organizers had yielded to the various enticements and pressures, the IC(P)Co. could have started with a considerably larger base capital.

DELTA IMPULZUS: Did they see such large imagination and profit in the goals of the company?

Csomai: Rather, the assets could have increased for two reasons. On the one hand, considerably higher capital investments were offered than the entry payments provided for in the preliminary agreements and, on the other hand, also offered were buildings and machines. The chief motive for the former offers was that, by increasing their own share, they could have gained greater influence on the work of the company. (the members gain a vote for every half a million forints contributed and the maximal amount of the share packets was ten million forints—publ.) and, in the latter cases, they wanted to rid themselves of fixed assets which were managed earlier at lesser profit and less advantageously. Of course, we did not exclude the possibility of accepting some of these at a later date, but only when we already have a clear picture of their profitable use.

DELTA IMPULZUS: Please describe in greater detail the organizational structure of the company.

Csomai: It is a classical stock company in which none of the shareholders who subscribe to the total of 150 million base capital has a commanding packet and thereby considerably greater influence than the others. Thus we work essentially in accord with the collective will of the shareholders. This is also in the basic interest of every shareholder because they can be more certain that they will receive the most optimal rate of dividends for their capital investment. The resolutions arrived at at the statutory meeting—this is the highest level of organ of the company—are binding on the board of directors, their performance is controlled by the supervisory committee, while we can rely on the scientific advisory body with respect to overall problems. At the statutory meetings, problems are debated which had been sent in writing to every shareholder, prior to the meeting, by the board of directors or by any of the shareholders. Thus everyone involved can make a valid contribution and well-based decisions can be made, promising good results with a high probability.

The working organization of the stock company—headed by the director general—consists of five directorates and a small number of central administrators. The chiefs of the directorates and the managers belong to the younger and middle generation with at least one higher education degree, minimally an intermediate knowledge of languages, or two or more university degrees behind them. When it comes to a new technical idea, every member of the relatively small collective—about 80 individuals—is involved in managing the innovation, so-to-say from the idea to establishing the enterprise. The company, registered in October of last year, achieved a 45 million forint trade with a 7 million forint profit during the three month period in 1987.

DELTA IMPULZUS: In the name of the company, why does the word "Park" appear only in parentheses?

Csomai: For a very simple reason: although we would like it, our company cannot yet be called an innovation park in the "true sense." Unfortunately, we cannot yet provide the indispensable conditions for it. In the absence of state support, the money needed for research activities whould have to be provided by us through our enterprises. Hopefully, this will be gradually successful, within 5 to 6 years, and we also hope that by then the social-economic background will change in a direction better suited for such type of efforts.

For example, we plan to take over a few buildings from the closing academic faculty in Kazincbarcika, belonging to the Technical University of the Heavy Industry, and, in the product manufacturing center to be set up there, we would start—on the basis of an agreement with the Chemical Combine of Borsod—the experimental production of high purity, so-called "9999" aluminum oxide. This we would use to create the basis for an about 300 million forint investment. The material, a ceramic oxide which is a basic material in microelectronics, is also a chemical-industrial alloy and catalyst as well as a tissue-compatible material and thereby is also of vital importance in medical practice. This work, for example, will already be a kind of "park-like" solution.

DELTA IMPULZUS: While a concrete plan is being discussed, please talk about your further plans and also your partners!

Csomai: Through our regional representatives, we are looking in every part of the country for utilizable technical innovations, inventions and ideas. In addition we would like to search for foreign research results ready for production and to establish a joint company for utilization. For example, from a research institute in Novosibirsk of the Soviet Academy of Sciences, we received recently for testing some pneumatic tools used in mining. And we have conferred with the innovation specialist enterpise working alongside the Polish organization corresponding to MTESZ [Federation of Technical and Scientific Associations] and, among others, also with the first Polish private stockholder company, the FLA-MAL.

In addition to the comprehensive tasks, we are accepting assignments which, although they appear less significant, are important to the customer and are providing us with decent profits, while our computer technological directorate is engaged in hardware and software trade, software development and the establishment of computer systems.

TELECOMMUNICATIONS R&D

Czechoslovak Telecommunications Stations Nearing 4,000 Mark

24020008 Prague TELEKOMUNIKACE in Czech No 10, 1988 p 146

[Article by Zdenek Bek: "Almost 4,000 Data Transmission Stations"]

[Text] Owing to an average rate of annual growth of data transmission stations connected to the Czechoslovak Unified Telecommunications Network by 19 percent over the past 10 years, the transmission of data is among the most dynamic telecommunications services offered in this country. Data transmission services were inaugurated in 1971. The growth in the number of data stations was limited in the first years following inauguration of the service by a shortage of the necessary computer equipment in the hands of users (suitable terminals as well as computers) and, on the side of the communications industry, particularly by the unavailability of the necessary assortment of modems.

Over the last few years, the situation is improving in this direction. The number of technical devices is greater and recognition by users of the possibilities for utilizing data transmission in information, control, reserve, and other systems of remote data processing has also increased. This was manifested in the heightened interest of the user sphere in data transmission services and in the

increased number of data stations, which is documented in Table 1, which shows the number of data stations attached to the Czechoslovak Unified Telecommunications System from the time the service was inaugurated until the 2d quarter of 1988. Table 3 shows the composition according to transmission speed. Provided that the upcoming period will also maintain an average growth rate of 19 percent with respect to the number of data stations, something of which I am convinced, then the number of data stations by the year 2000 will reach the individual annual levels shown in Table 2.

Table 1. Number of Data Stations Connected to the Czechoslovak Unified Telecommunications Net

Year	Number of Data Stations	Interyear Growth of Data Stations	
		each	percentage
1971	6	—	—
1972	51	45	750
1973	110	69	135
1974	200	90	81
1975	310	110	55
1976	481	171	55.2
1977	611	130	27
1978	762	151	24.7
1979	946	184	24.1
1980	1157	211	22.3
1981	1326	157	11.8
1983	1789	306	19.4
1984	2024	235	13.1
1985	2407	383	18.9
1986	2835	428	17.8
1987	3513	678	23.9
1988/2Q	3934		

Table 2. Numbers of Data Stations in Individual Years, Provided Their Interyear Growth Rate Is Maintained at 19 Percent

Year	Number of DS at 19-Percent Interyear Growth Rate	Corresponding Interyear Growth of DS
1988	4180	667
1989	4974	794
1990	5919	945
9th Five-Year Plan		
1991	7044	1125
1992	8383	1339
1993	9976	1593
1994	11871	1895
1995	14127	2256

Table 2. Numbers of Data Stations in Individual Years, Provided Their Interyear Growth Rate Is Maintained at 19 Percent

Year	Number of DS at 19-Percent Interyear Growth Rate	Corresponding Interyear Growth of DS
10th Five-Year Plan		
1996	16811	2684
1997	20000	3189
1998	23806	3808
1999	28329	4413
2000	33712	5383

Table 3. Composition of Data Stations (DS) by Transmission Speed

Transmission Speed (bits/sec)	Number of DS	Share of DS
Up to 200	942	25.1
600/1200	2297	61.2
2400	233	6.2
4800	52	1.4
9600	131	3.5
parallel	98	2.6
Total	3753	100.0

We may draw certain conclusions from the listed facts which will help us to become oriented in estimating the further development of data transmission services. Thus, given the existing development of the number of data stations, we can conclude that it took 10 years to reach a level of 1,000 stations and 3, or rather 2.5, years to achieve another 2,000 stations, whereas in the last year of the present 5-year plan the same growth rate will be achieved in a single year. During the period of the 9th and 10th Five-Year Plans, for example, in the year 1995, so many data stations would be attached to the Unified Telecommunications System as was the case during the first 14 to 15 years. This fact cannot fail but be reflected in the requirement for manpower for these services as well as in the requirement to create conditions in the telecommunications network itself. To assure the data transmission services means to expand the assortment of necessary facilities for the transmission of data (modems, expansion particularly of local telephone networks, expansion of automatic telephone contacts for long distance service, etc.). All of these considerations, for the time being, deal with the extent of data transmission services. However, there are even other viewpoints. At the end of the 1st quarter of 1988, a total of 1,194 data stations were operating on leased telephone circuits, compared with 1964 data stations operating on commutative telephone circuits. The large number of leased circuits in use, together with the requirement to grant access to interested parties—users of data—to databases at home and abroad, as well as the requirement for new applications of remote data processing in management

and informational systems call forth the requirement to create a public data network, as a part of the technical means operated by the various communications administrations in a substantial portion of the developed countries. These public data networks serve not only the purposes of data transmission, they are also a transmission environment for other services which have become known as telematic services.

Even in our country, we have embarked this year on the inauguration first of a telefax service and a postfax service. Other services are under preparation, particularly teletex services, the inauguration of which is planned beginning with the 9th Five-Year Plan. We are, for the time being, compelled to support these services on the basis of the current telephone network, even though a Public Data Network would better serve these purposes. In conjunction with considerations and, particularly, with the practical introduction of telematic services and the expansion of data transmission services, it is necessary to figure that these new, one could say nonconversational services, will exert an effect upon the existing telex services or upon the public telegraph service. With respect to the telegraph service, a decline has been noted for many years; a decline in the domestic operations of the telex service has now also been noted. Moreover, if we look at the prognosis of the number of data stations during the period of the 9th and 10th Five-Year Plans and if we look at the anticipated number of telex subscribers, then, approximately around the year 1995, the number of data stations begins to exceed the number of telex subscribers. This fact must also be taken into account in developing the communications networks as early as the year 2000. At the beginning of data transmission services, questions arise as to whether and in what time frame the number of data stations might exceed the number of telex subscribers. In fulfilling the above-listed considerations, this will occur around the year 1995—in other words, roughly 24 years after inauguration of data transmission services.

We can have similar considerations in the current period when we are inaugurating additional telefax services (user service). It is possible that the number of telefax stations will never exceed the number of telex subscribers. During the current period, this service will be slowed by the unavailability of the required terminal facsimile equipment and by the unavailability of special heat-sensitive paper in Czechoslovakia or in the CEMA countries. However, personally I believe that, from the standpoint of a character and particularly because of the requirements for telefax services, the growth in the number of subscribers could be more rapid than was the case with respect to data transmission services, provided a sufficient quantity of equipment and paper is available. After all, the establishment and purposeful functioning of a data station is tied to the fulfillment of a number of prerequisites (to have available a terminal, modems, and, possibly, a leased circuit; next, it is necessary to fulfill programming support problems, etc.). In establishing a telefax station, these prerequisites disappear and, given a certain degree of simplification, the establishment of such a station is equivalent to establishing a telephone subscriber station. After users become familiar with the high user benefits, when the transmission of text, graphics, and possibly other types of information virtually to any place on earth takes approximately 1 minute using the A4 format, interest in this type of service can expand greatly.

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